



The Blast Furnace *and* Steel Plant

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The Blast Furnace *and* Steel Plant

Vol. XIII

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No. 4

Two Points of View

RESearch resolves itself into a question of mentalities more than a question of materials. Such is the conclusion drawn by Charles F. Kettering, President of the General Motors Research Corporation, Dayton, Ohio. ¶ Traditional adherence to false standards and conceptions is the first and highest hurdle which the trained investigator must overtop. "Down the blind alleys," where tradition has set the seal of a closed door—there are often found the great underlying truths.

The man who says, "It can't be done," voices merely his own inability to conceive; the man who acknowledges that something is "wonderful" admits the validity of a thought and discloses his own open-mindedness.

These two points of view are entirely typical of progress within the steel industry; in fact, of all progress. The first is a static condition culminating in decay, the other is a live condition susceptible of healthy growth.

In these wearing days of intense competition, when progress is possible only after scrutiny of every conceivable element entering into the total process, fortunate indeed are those concerns whose guiding minds are willing to travel the "blind alleys."

Some Revelations by Deep Etching*

Deep Acid Etching Brings Out Such Defects as Fine Hair-Line Cracks and Solid Non-Metallic Inclusions That Are Not Ordinarily Visible Under the Microscope

By J. FLETCHER HARPER†

This article discusses the acid etching of forgings and castings for the purpose of inspecting the soundness and fitness for use of the materials under examination. The author draws certain conclusions as to the advantages of this method of inspection. Chief among the advantages are the identification of the presence of fine hair-line cracks and solid non-metallic inclusions. These will be opened up into deep pits or slots as a result of the acid etching. To a considerable extent it is possible to identify the method of manufacture by which the particular specimen under examination had been manufactured in the steel mill.

THE text of this article embraces some experiments conducted by the writer prior and subsequent to the work done by Hoffman and Waring‡ on the deep etching of rails, published in 1919. Although some of our readers may not agree with all of the points brought out in the present paper, it is hoped that what is given may be of help as a method of solving some of the so-called steel mysteries.

In the early part of 1918, our company was suddenly confronted with a number of rejected forgings. These forgings consisted chiefly of shafts which were made of 3.00 to 3.50 per cent nickel steel, and subject to our specification class "FS-D", which has the following requirements:

- Elastic limit of 50,000 lbs. per sq. in..
- Ultimate strength 80,000 lbs. per sq. in.
- Elongation in 2 in.—25 per cent.
- Reduction of area—45 per cent.

We had been producing these forgings for a considerable period of time and had no difficulty in meeting the specifications with a standard heat treatment. These defective forgings, however, were revealing conditions such as are shown in Table 1. It will be observed that in all but one instance the materials met the specification for elastic limit and tensile strength, but were low in elongation and reduction of area. To cope with the situation, we altered the temperature of annealing, the temperature of quenching and the temperature of tempering, but with no better results. Chemical analyses were made of these materials, and in all cases the composition of the steel was as specified. Microscopic examinations revealed good structures with the exception of some minor inclusions and cracks in certain sections, but otherwise entirely free from defects. The photomicrographs of the defective areas of some of the steels examined are shown in Figs. 1, 2, 3 and 4.

*A paper presented before the Cleveland Chapter, American Society for Steel Treating and reprinted from the Transactions of the Society.

†Research Engineers, Manufacturing Department, Allis Chalmers Manufacturing Company, Milwaukee, Wis.

‡Hoffman and Waring on "The Deep Etching of Rails" presented before the annual meeting of the American Society for Testing Materials, June, 1919.

Upon casual examination of these photomicrographs it would appear that the difficulty was due to dirty steel and that the results of the physical tests bore out this conclusion. These, however, are a few of the worst photomicrographs which were taken. Hundreds of samples were examined, some of which showed only a minor number of sonims (solid non-metallic impurities), others showed a major number of sonims in one section and a minor number of sonims in an adjacent section, and still others were entirely free from inclusions. It was at this point of our investigation that our first work on deep etching with

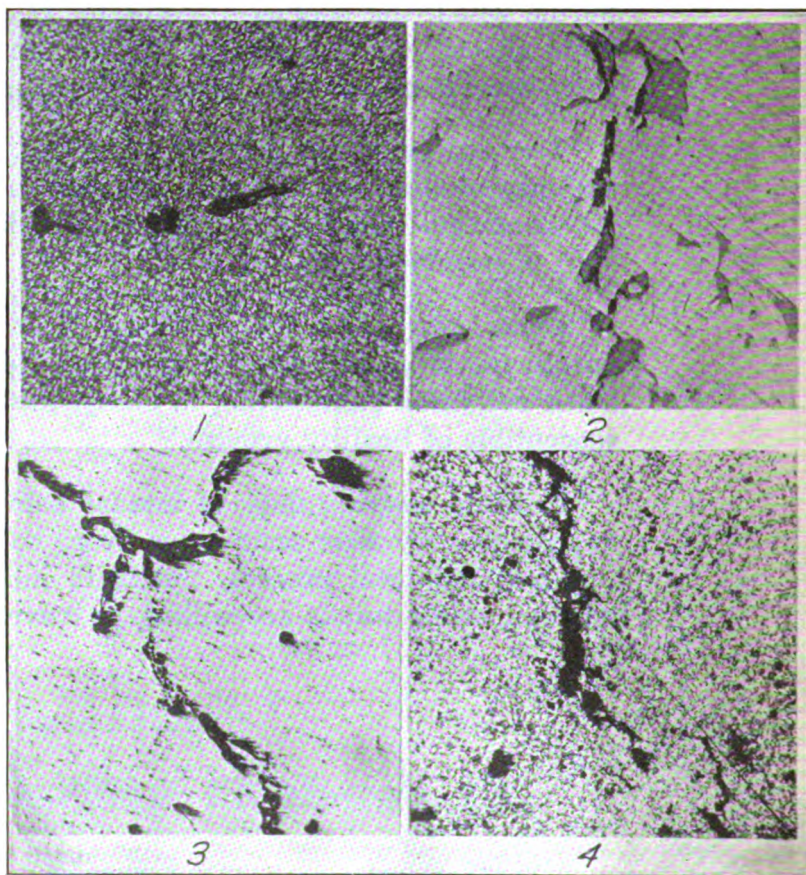


FIG. 1—Photomicrograph of a 3.50 per cent nickel steel etched with picric acid, 100x. With the exception of the inclusions, this structure is quite satisfactory. FIG. 2—Photomicrograph of a similar piece of steel showing minor sonims and a large fissure, 100x. FIG. 3—Photomicrograph of a 3.50 per cent nickel steel, unetched, 100x. FIG. 4—Photomicrograph of the same specimen, etched, showing a large fissure and numerous sonims.

acids started. Deep etching was accomplished by heating a piece of steel of definite size for a given time, in a solution of concentrated hydrochloric acid.

It was found that by duplicating deep acid-etching conditions as nearly as possible in each test, we were able to make excellent comparisons between samples. In these etching tests it was noted that steels of different analyses varied in solubility and that the rate of solubility varied according to the amount of mechanical work which had been done upon the piece. Different annealing temperatures on the same steel caused differences in solubility. It was noted that steels made by the acid open hearth, basic open hearth or electric furnace methods could be distinguished one from the other, due to differences of solubility of steels of similar analysis. It was with great ease that samples taken from forgings made from sand-cast and chill-cast ingots could be distinguished. These points are brought out simply to show the wide range and the possibilities of comparison of similar samples subjected to the deep acid etch. Figs. 5, 6, 8 and 9 show the results of some deep etching tests made on bars cored from forgings. Fig. 5 shows a bad surface condition with considerable pitting following the acid etch. The physical test properties of this specimen is shown in Table 1, text 1064. The elastic limit, elongation and reduction of area are below the specifications. Photomicrographs of this specimen are shown in Figs. 3 and 4. It will be noted that these three different methods of test lead to the same verdict, that is, that the steel was dirty and contained many sonims.

Fig. 6 shows a specimen with less pronounced pits than those of Fig. 5. In order to establish whether or not these pits were in the center of the specimen, as well as on the surface, the same specimen was cut transversely and longitudinally and then deeply etched. After etching, the specimens were closely examined and it was found that where a fissure or pit existed on one segment there was a corresponding pit on the matching segment. Pitting occurred on interior sections as well as on the surface.

Fig. 7 shows a bar of rolled wrought iron after it has been deeply etched. The rough fluted condition of the surface is due to the fact that the slag lines or inclusions in the bar have been eaten away by the acid, thus revealing the piling.

Fig. 8 shows a sound bar of steel after it has been deeply etched. With the exception of the fissure at the extreme upper end of the bar, this specimen shows no pitting or fissures. The crack at the top of the bar was produced by mechanically breaking the specimen, which upon deep etching was enlarged to a fissure. Such hair line cracks which open up as fissures during deep acid-etching may be produced by extreme internal stress, or by impact. It has always been found that these fissures occur at right angles to the line of stress in the material and are apparently always intercrystalline as compared with intracrystalline cracks which are inherent in the material due to conditions of manufacture.

Some time subsequent to making these tests we were having difficulty in hardening certain areas of a gas engine cam shaft. These soft areas always appeared in the same location on the shaft regardless of the method or condition of heat treatment. Deep etching of numerous specimens cut from different cam shafts revealed the conditions as shown in Fig. 10. The parting line of the forging die was at the part of this cam which was giving difficulty in hardening. In the forging of a cam shaft, due to the nature of its shape, the material flows in a horizontal direction until it meets the closed faces of the die, or until the flash chills. The material then flows perpendicularly upward and downward to fill the die. If ample curvature is not provided, or the dies are not brought down with the minimum thickness of flash, a number of fiber-like ends of worked-material are left on the forging at the parting of the dies. The mechanical working of steel between dies tends to move non-metallic particles toward the parting line of the die, resulting in a concentration of these inclusions at the point where the best metal is wanted. Further examination of these specimens showed that it was evident that the trimmer die was not functioning properly and was tearing the metal in shearing, resulting in voids or fissures at the parting line of the dies. To properly carburize and harden such material is of course quite impossible.

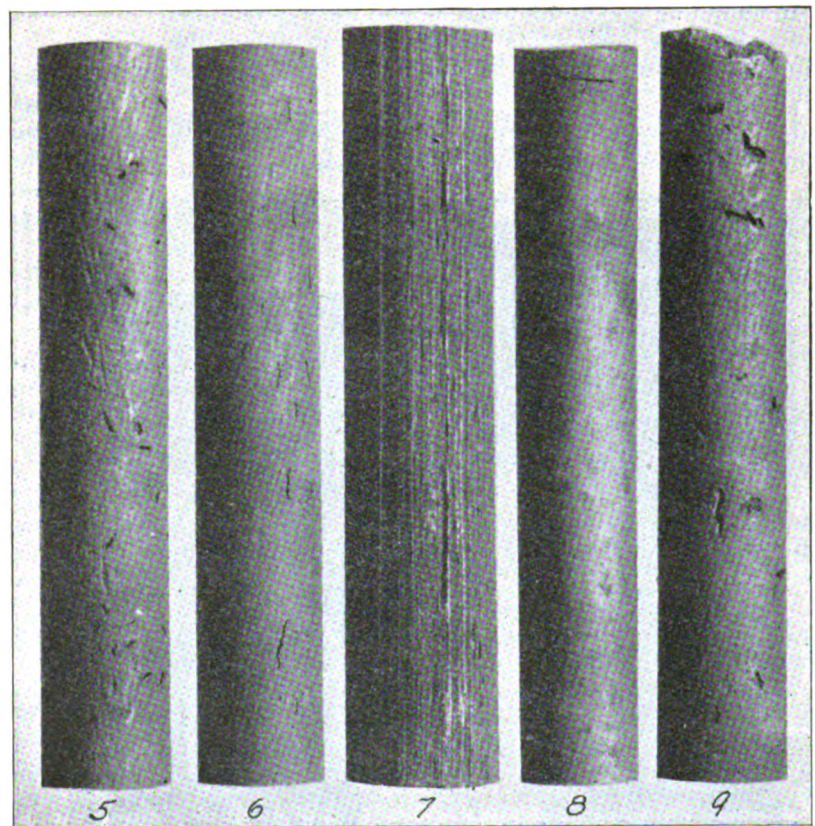


FIG. 5—Photograph of a deeply etched bar showing many deep pits on the surface. FIG. 6—Photograph of a deeply etched bar showing fewer surface pits and cracks. FIG. 7—Photograph of a deeply etched rolled wrought iron bar showing a very rough surface resulting from the etching away of the elongated slag inclusions. FIG. 8—Photograph of a deeply etched sound bar showing an absence of pits and cracks with the exception of a minor fissure at the top of the bar which was caused by mechanically breaking the bar. FIG. 9—Photograph of a deeply etched bar showing very deep surface pits; photomicrograph of this bar is shown in Fig. 3.

Fig. 11 shows a deeply etched hardened cam which contains many grinding cracks resulting from the use of an improper grade of grinding wheel or an improper feed and speed of grinding. These results can also be produced by the use of proper grinding equipment if the structure of the material contains excess free cementite near the surface.

It has been found that only in rare cases could surface cracks be produced by deep etching alone and then only on materials containing high internal stresses due to drastic heat treatments. Similar cracks usu-

TABLE I
PHYSICAL TESTS OF DEFECTIVE FORGINGS

Test No.	Elastic Limit lbs. per sq. in.	Ultimate Strength lbs. per sq. in.	Per Cent Elongation in 2 in.	Red. Area	Fracture
Required	50000	80000	25	45	
1065	57000	95000	14	17	Angular
1065 C.	62800	92700	18.5	28	Angular
1065 A.	52900	85900	21	27	Angular
1288 B.	55800	86520	6	10	Angular
1075 A.	56900	82000	15	21	Angular
1064	48550	85150	15	24	Angular

ally appear upon aging such hardened material, due to the fact that the material has many internal stresses which are relieved upon long standing or aging. Deep etching accelerates these aging cracks.

Summary.

In summing up the advantages and the applications of deep etching with acids to the examination of the materials of construction, we find that this method will reveal:

1. That steels of varying chemical analysis will show varying rates of solubility in the acid.

2. That steel with heterogeneous composition will have a relatively rougher surface condition due to the differences in solubility of the different parts of the specimen. Sonims and cracks will produce pits and slots.

3. That the same steel varies in solubility when given various heat treatments.

4. That it is possible, to a certain extent, to identify the method of manufacture of steels of similar analysis due to their varying rate of solubility in the acid etch. The fact that there are differences in rates of solubility of these steels may lead to the explanation of the differences in physical properties of acid open hearth, basic open hearth and electric furnace steel of apparently identical composition.

5. That forgings made from chill-cast and sand-cast ingots show a marked difference in cleanliness and a slight difference in solubility.

6. That incipient cracks in all cases of defective steel examined, were intracrystalline and in all directions although tending to be elongated in the direction of the mechanical work.

7. That cracks occurring in steel due to mechanical strain appear in a direction perpendicular to the stress in the material and in all cases examined, were intercrystalline.

J. H. Taussig Dies

John Hawley Taussig, gas engineer of the U. G. I. Contracting Company, inventor of gas-making apparatus, and in the late nineties a famous Cornell football player, died yesterday at the Chestnut Hill Hospital, Philadelphia, where he had been ill for a short time.

Mr. Traussig, who was 49 years old, lived with his wife and three children on East Gravers Lane, Chestnut Hill.

He was a son of the late Rear Admiral Edward David Taussig, U. S. N., and a brother of Captain Joseph K. Taussig, U. S. N., a member of the War College at Newport, R. I. Another brother is Charles A. Taussig of New York City.

Mr. Taussig was one of the most noted athletes developed at Cornell University. He played right end on the football team from his freshman to his senior year and was picked for All-American teams.

Following his graduation in 1897 he was in the engineering department of the Philadelphia Gas Works for three years. Then he went to Newark, N. J., as superintendent of the Market Street Gas Works, but three years later returned to this city as assistant engineer of tests with the U. G. I. He had been with that corporation since. A few years ago he was recipient of the Edward Longstretch Medal, awarded to him for his inventions in gas apparatus by the Franklin Institute.

He was a member of the American Society of Mechanical Engineers, the American Gas Association, the Natural Gas Association, the Illinois Gas Association and the Franklin Institute. He was also a member of the Philadelphia Cricket Club, the University Club, the Cornell Club and the Delta Upsilon Fraternity.

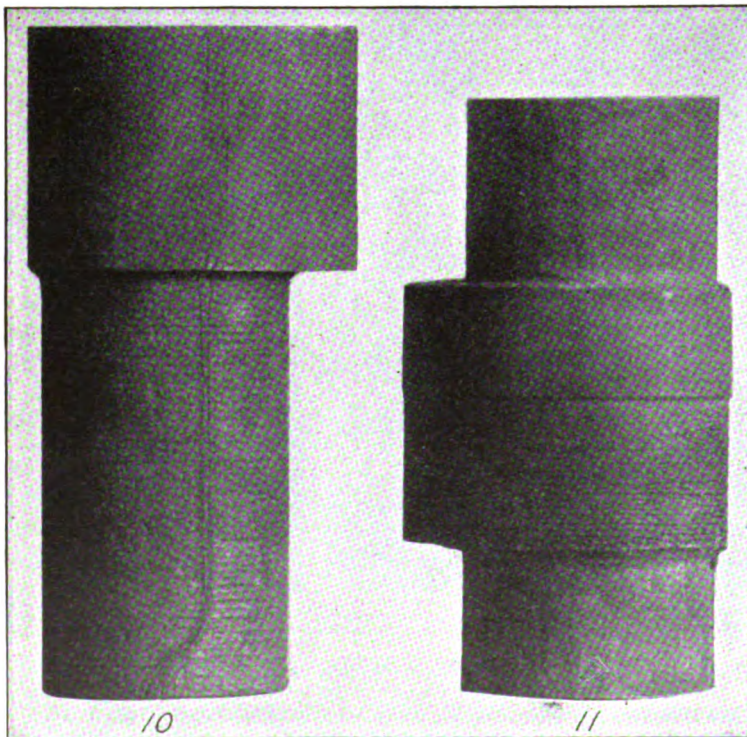


FIG. 10—Photograph of a deeply etched cam. It will be noted that deep lines appear on this material at the parting line of the die.
FIG. 11—Photograph of a deeply etched hardened cam containing many grinding cracks due to the use of an improper grinding wheel, and improper feed or speed.

Pittsburgh's Vaulting University

Plans for Remarkable Structure May Revolutionize Educational Ideas in Large Cities

AT first glance, the architects' visualization of the new "Cathedral of Learning" is a distinct shock to all the traditions of college and university trained men. Further analysis forces upon us a further and more rational conclusion. Instead of giving up some small traditional undergraduate privileges, the future students and post-graduates of this greater university will find themselves possessed of educational and research facilities entirely denied the average college man; and the city, the community known as Pittsburgh, will be able to supplement the practical work of its every day commercial life with avenues of observation and studies of theory previously undreamed of.

Such men as Judge Elbert H. Gary, Andrew W. Mellon, Homer D. Williams, Hamilton Stewart, and a thousand similarly minded do not lend their efforts to phantasy.

Pittsburgh needs just such an institution, and Pittsburgh is taking the steps, today, which may make this city the birthplace of discoveries and inventions as epochal as Madame Curie's discovery of radium or Professor Langley's experiments that paved the way for the aeroplane.

So many of the revolutionary discoveries of recent years have come from the researches in university laboratory that the gathering together here of perhaps the greatest array of university research laboratories in the world is being hailed by scientists as offering untold potentialities.

This mobilization of laboratory facilities is to be one of the outgrowths of the University of Pittsburgh's plan for the erection of a 52-story "Cathedral of Learning." With the space which this huge building will make available for the university, it will, for the first time, be able to satisfy the long-standing need for adequate space and facilities for the pursuing of scientific researches and industrial investigations.

More than \$4,000,000 of the total cost of the "Cathedral of Learning" will be represented in the construction of laboratories. There has been probably nothing approaching this in university history. No one can predict what extraordinary discoveries may be ferreted out—or stumbled upon—during the researches that will go on in this array of laboratories, with the modern facilities that will be placed in the hands of students and faculty members.

The best indication of what may be expected from this mobilization of laboratories is found in the fact that 80 per cent of all appliances and processes used in modern industry were discovered during researches in university laboratories.

Charles M. Hall, while a student at Oberlin College, made possible the commercial development of aluminum.

Professor Walter Reed of George Washington University made experiments which resulted in the means for practically wiping out yellow fever. Von Behring, another professor, reduced diphtheria danger 90 per cent. As a result of these and similar discoveries

emanating from universities the death rate in this country has been reduced more than 30 per cent.

Newton, a professor at Cambridge, formulated three laws of motion which, in large part, constitute the foundation of all modern engineering and physics. Watt, while an instrument maker at the University of Glasgow, invented the governor of the modern engine, as well as a separate condenser, and the double-acting cylinder. Faraday, another professor, made possible the telephone, dynamo and most of the modern electrical conveniences through his discovery of the laws of magnetic induction.

Professor Maxwell, also at Cambridge, aided later by Professor Hertz, produced the electro-magnetic waves which are used in wireless. Professor Pasteur's experiments with bacteria and ferments prepared the way for the canned goods industry and made possible many marvels in preventative medicine.

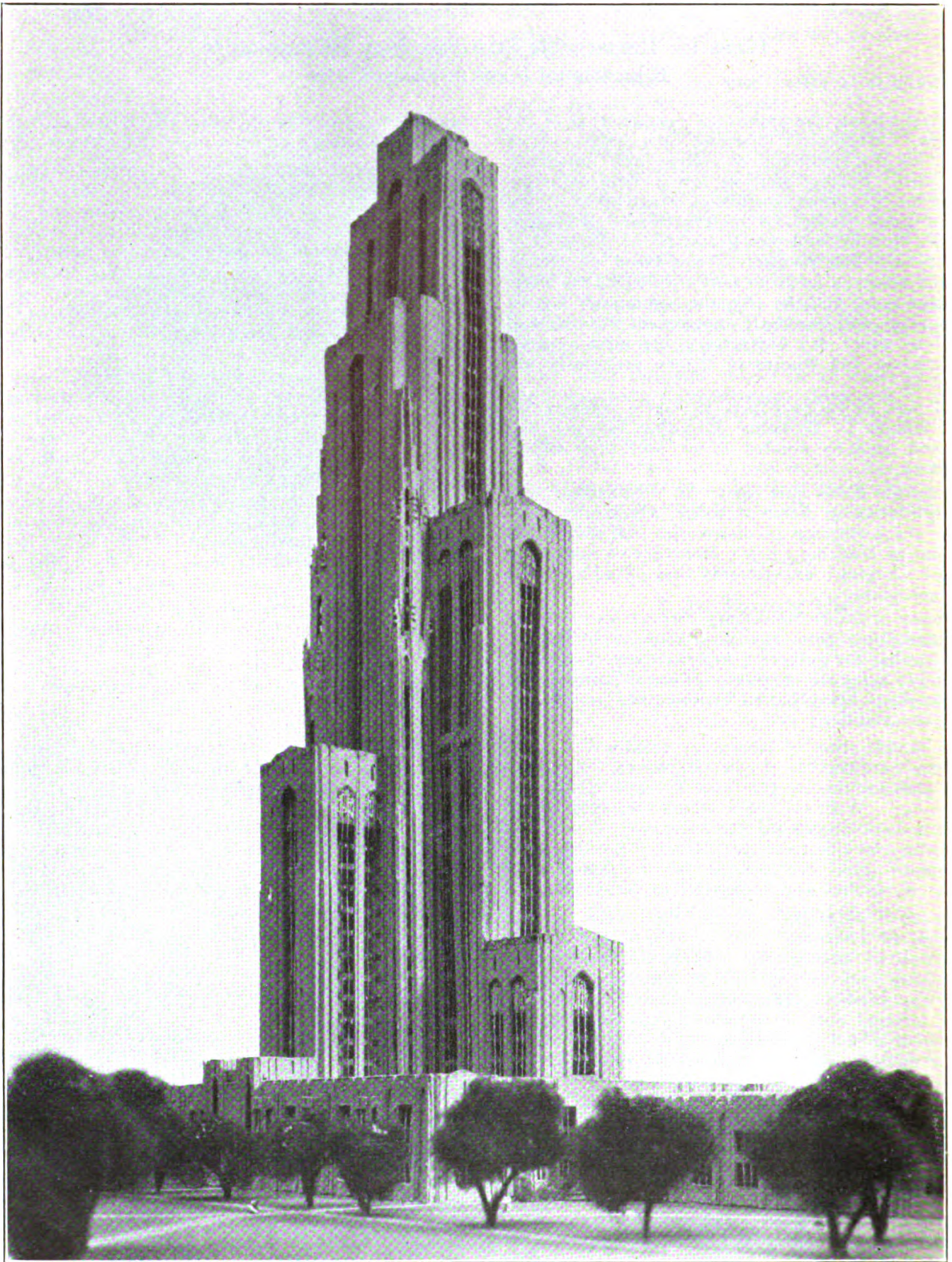
Experiments in bio-chemistry at the University of Minnesota made possible the raising of corn in Minnesota and the establishment of the dairy industry there, thus insuring the economic life of that state.

Discoveries no less important than these have come out of the researches carried on in this city at the University of Pittsburgh. Aviation admittedly had its birth in the experiments made by Samuel Pierpont Langley while professor of physics at Pitt. Professor R. A. Fessenden's researches into wireless, while at the university here, were so far-reaching in effect that the statement has been made in recent years that he was probably the real father of radio. Professor W. W. Strong's experiments made possible much of the recent progress in the abatement of the smoke nuisance.

But perhaps the work of the Mellon Institute at the university provides the best forecast of the kind of progress which may be expected from the establishment here of the fullest possible research facilities. The Mellon Institute was given to the university for the purpose of providing laboratories and other facilities for the solution of the practical problems of modern industry. Business concerns of all kinds take to the institute the obstacles which are confronting them in their work.

Amazing things have been developed in the course of these researches. The making of bread was revolutionized by one discovery. The activity of yeast was enormously increased by another. Laundries discovered certain facts regarding soaps that led them to make drastic changes in the kinds they use. Refractories manufacturers found out facts about clays which enabled them to use hitherto rejected clays and which made them reject hitherto accepted clays.

One of the recent discoveries at the local institute and one which illustrates the unexpected avenues which open up before research was the accidental finding of a new material which now has wide commercial use in the making of radiator caps for automobiles and the manufacture of all manner of electrical devices. This product was discovered during the course of experiments in which a number of big furniture



To the spirit of achievement in Pittsburgh. Nearly 15,000 tons of steel will be required in the construction of this Cathedral of Learning.

manufacturers were trying to develop a better varnish. So important was the material thus discovered that a \$10,000,000 corporation was developed to produce and market it.

This illustrates forcefully the truth of the statement that "any trained man has a chance of finding something new and useful in any research in an unknown field of knowledge," and the building of all the laboratories which will be included in the "Cathedral of Learning" will not only provide the facilities for research, but are calculated to attract to Pittsburgh the trained men, like Langley and Fessenden, whose lives are, in many cases, devoted to such researches.

In very many cases men of great ability and great devotion to their visions deliberately ally themselves with the faculties of the colleges or universities which can best provide them with the facilities they require for carrying on the researches upon which they are engaged. The attraction which the vastly-enlarged facilities of the University of Pittsburgh will have for these men may result in many notable accessions to the faculty here. These will result not only in the discoveries which may come from these men alone, but in the researches which men of this type will inspire in the students who are associated with them.

If we may believe Judge Gary, "There has been adopted a plan which will provide an educational home for 12,000 or more students at a time. The capacity is very large. The form is monumental; it is unique. To be built largely of steel and stone, it will be massive, permanent and beautiful in its architectural symmetry and proportions. It will receive the admiration and the wonder of the world. Its physical height is limited to 680 feet, but the height and breadth of its influence can never be measured by figures or words. In many respects it will not be surpassed. Throngs of people will come to Pittsburgh to gaze upon this remarkable tower of solidity and grandeur."

Consideration of the building itself emphasizes Pittsburgh's unique place in the building industry, in the steel industry and allied pursuits.

Almost everything in this 52-story building can be procured in the Pittsburgh District, according to E. F. Blakeslee, general superintendent of Stone & Webster, Inc. Mr. Blakeslee is now in Pittsburgh directing the construction of the university's huge stadium and he declared that Pittsburgh is an ideal situation for the construction of the "Cathedral of Learning" building, since Pittsburgh is the district which supplies many of the materials which go into most of the large buildings in the country.

The Pittsburgh District, once famous for making great quantities of basic materials and very few finished products, is now turning out great quantities of diversified finished products and has become the center for building materials.

Pittsburgh is the greatest tonnage producing point in the world. Nowhere else will be found a like grouping of coal fields, intimately connected with the most modern by-product coke ovens of capacity enormous enough to serve 30 or more 500-ton blast furnaces; blast furnaces tapping their iron into hot-metal cars for quick transfer to adjacent open hearth furnaces great enough in capacity to convert all this and more into ingots which are rolled into finished steel; the very wastes of heat from these steel processes alone are recovered into power from blast furnace gases, coke-ovens and open hearths, massed into a natural

super-power system which serves to energize the motored activities so necessary to competitive rolling.

While the total steel producing capacity in the United States aggregates about 54,000,000 tons annually, more than 13,000,000 will be found within the Pittsburgh District.

The city's great steel industries were one reason for this, as great steel fabrication plants have been developed in the district because of the steel plants. The steel in the university's "Cathedral of Learning" building will represent probably 10 to 15 per cent of the cost of the building.

There has also been a concentration in the Pittsburgh District of great plants for the manufacture of electrical supplies and electrical devices, and in this field, too, the university's home district will be able to supply all the needed materials. Famous plants for the manufacture of plumbing materials and valves and fittings are located in the Pittsburgh section, too. Heating, sanitary and lighting fixtures for the new building will also be available in the immediate Pittsburgh district.

Local cement mills, brickyards, terra cotta plants, glass plants, pipe mills and similar plants will provide the other materials for the new building.

Practically the only large items which will not be available in Pittsburgh for the building will be the building stone and the elevator supplies.

The University of Pittsburgh's building is to cost approximately \$10,000,000, and about 125 prominent Pittsburghers have constituted themselves a Citizens' Committee to finance the project. A public subscription will be part of the financing plan and a large organization has now been built up for that work.

The building is to be located in the center of a 14-acre tract of property in the Schenley district of Pittsburgh, the property having formerly been the property of H. C. Frick. The main portion of the building will be 260x260 feet, with wings on the front, giving it an over-all front dimension of 360 feet. The building will be of steel construction faced with Indiana or Kentucky limestone. It will be one of the tallest buildings in the world and will provide accommodations for the entire university with the exception of the medical and dental schools, which are to occupy the present campus buildings.

Homer D. Williams, president of the Carnegie Steel Company, is heading the Citizens' Committee which is handling the campaign for the university.

THREE MORE FURNACES AT YOUNGSTOWN

The Youngstown Sheet & Tube Co. has contracted with the Chapman-Stein Furnace Co. of Mt. Vernon, Ohio, to build three recuperative billet heating furnaces at their Brier Hill Plant, Youngstown, Ohio.

The recuperators will be of the refractory tile type, which operate without fans. The stack-like action of the vertical air flues in the recuperator serves to deliver an abundance of air to the furnace ports at a positive pressure and preheated to around 1400 deg. F.

The three furnaces to be built follow previous similar installations by this company made during the last three years. They will be used for heating slabs for their 84-in. mill at the Brier Hill plant. This policy of replacing old furnaces with the most up-to-date furnace designs is in keeping with the spirit of progressiveness expressed by this company in everything they do.

SHEET AND TIN PLATE

Furnace Volume Comparisons

A Series of Studies of Powdered-Coal Fired Heating Furnaces in Relation to Present Boiler Combustion Chambers

By J. G. COUTANT*

THE efficient utilization of fuel in the powdered form depends on the correct design of the furnace and upon the proper operation. Or, in other words, furnaces should be designed according to the process of combustion of the combustible substances while in suspension and which must be burned within the furnace.

The knowledge of these processes would make it possible to determine the proper design of the combustion space, also the furnace hearth or boiler for the efficient utilization of heat in the products of combustion, and to eliminate any concentrated high temperature zones that would cause the deterioration of brickwork.

Comparatively few studies have been made for the direct purpose of determining the processes that

*Furnace Engineering Company, New York City.

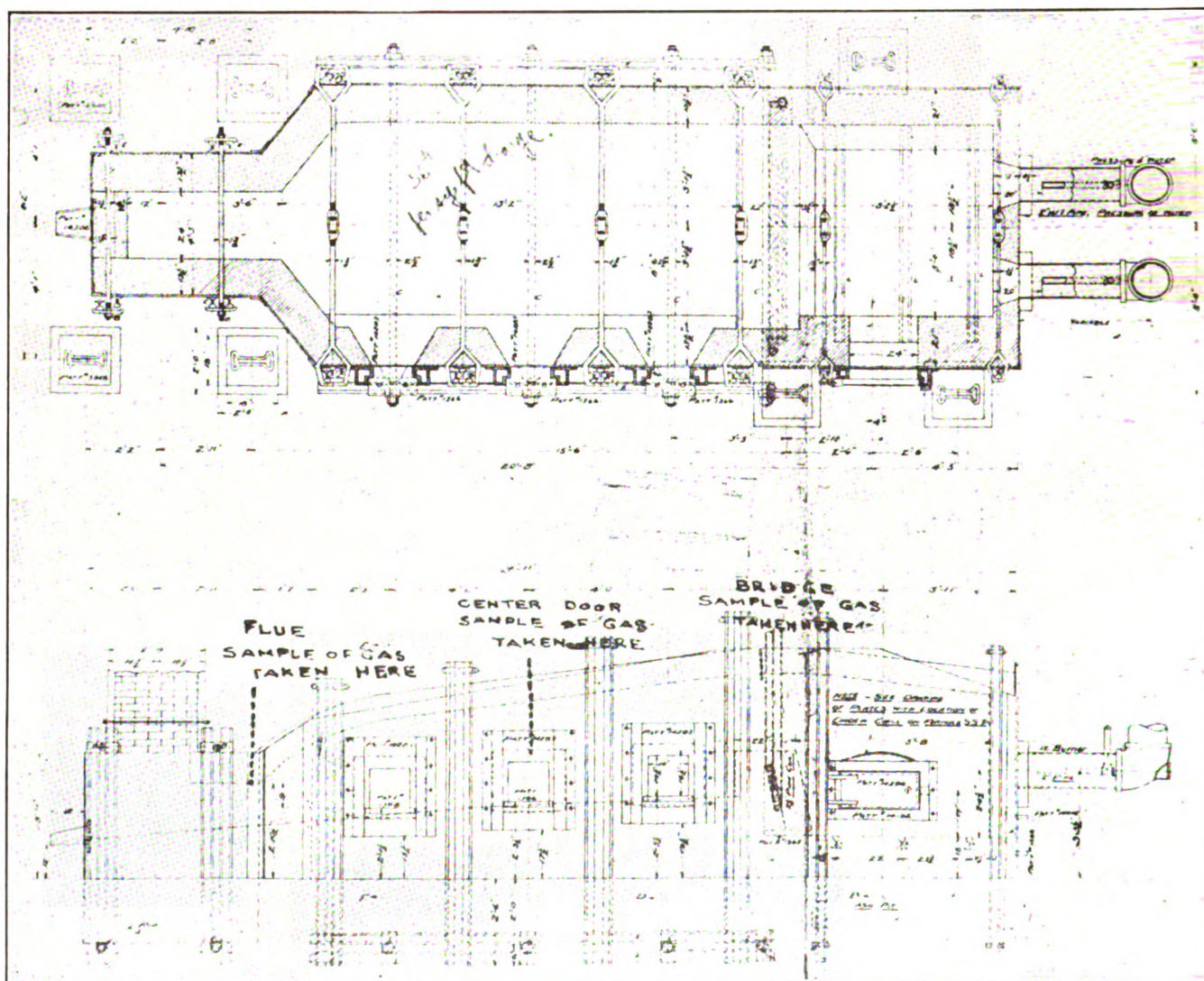
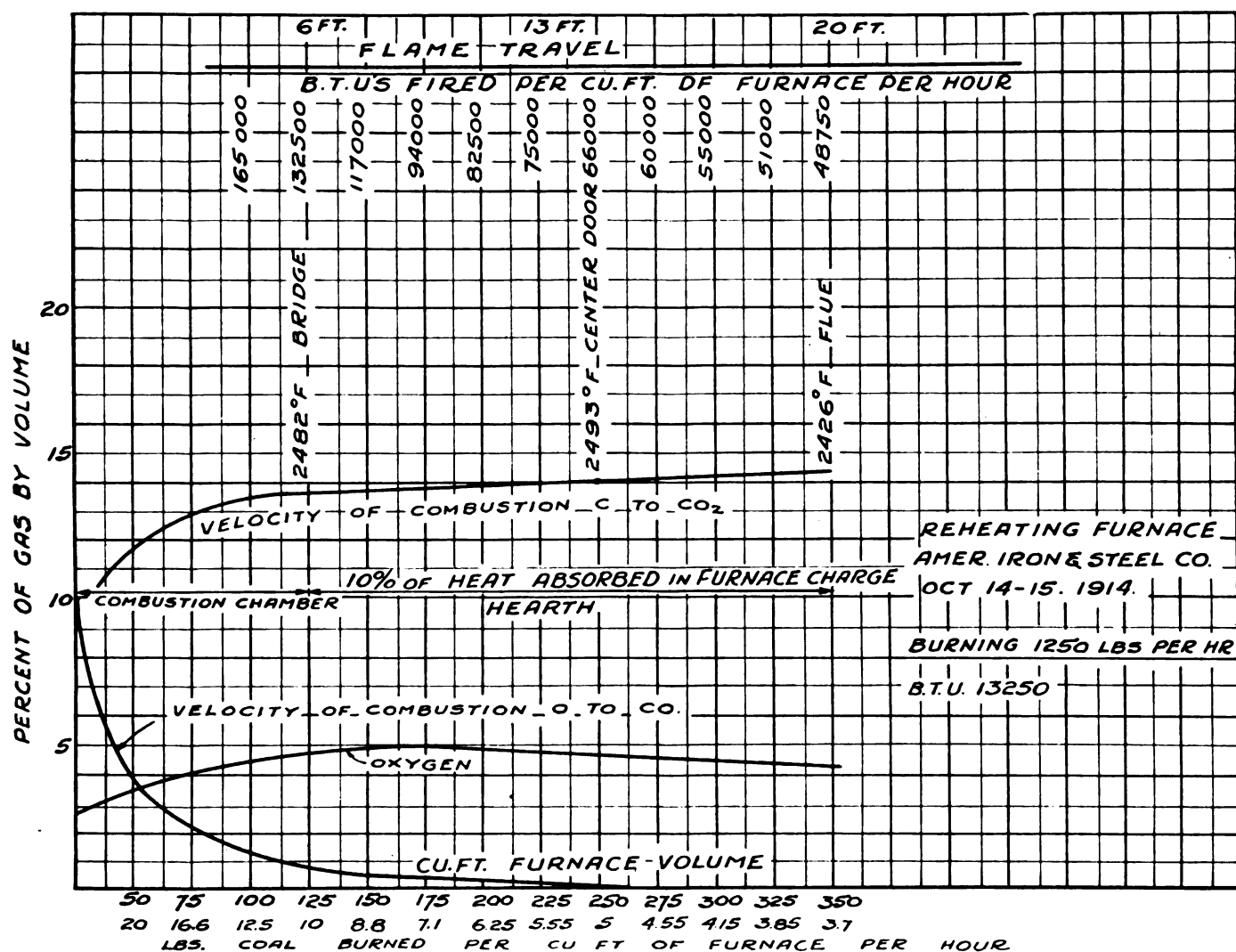


FIG. 1—Two views of heating furnace upon which the American Iron & Steel Company conducted an investigation. Note the points where gas samples were taken.



occur in furnaces during normal operation. The American Iron & Steel Manufacturing Company some years ago conducted such an investigation in connection with a 3-door, 6 ft. x 13 ft. hearth re-heating furnace used for rolling mill work. The furnace shown in Fig. 1 had been developed by the cut and try method until they obtained satisfactory performance. It was then decided to study this furnace to obtain such data that would enable one to build other furnaces as equally efficient.

Trials were made during two days under working conditions, observations and gas samples, etc., were taken at the time of maximum of fuel consumption when the metal charge was sufficiently heated (temperature 2460 deg. F. to 2540 deg. F.) to draw from the furnace, and at which time the coal was burned at the rate of 1250 lbs. per hour. The coal pulverized to a fineness of 89.07 per cent, passing through a 100 mesh screen, and 70.82 per cent through a 200 mesh screen.

ANALYSIS OF COAL AS FIRED

Fixed Carbon	54.86
Volatile	32.68
Moisture	0.74
Ash	11.72
Sulphur	1.85

The temperatures were obtained from many observations by means of a Thwing radiation pyrometer. It is probable that the temperature shown indicates the

temperature of the metal charge from which the heat absorbed by furnace charge was calculated. Therefore, the temperatures shown are approximately 200 to 300 deg. F. lower than the actual temperatures of the products of combustion at the various points.

The gas samples were taken at points shown in Fig. 1, and analysis made with an orsat set. It is probable that the CO₂ curve shown on chart, Fig. 2, might be 1 per cent too high.

The accurate sampling of gases under working conditions with old time rolling mill men, were difficult to obtain, and the values shown on chart are the average results.

The powdered coal combustion may be studied from this chart or curve that will afford an opportunity for one to have some idea of the velocity of combustion, completeness of combustion. Btu. fired per cu. ft. of furnace per hour, flame travel, lbs. of coal burned per cu. ft. of furnace per hour, the per cent of main constituents of furnace gases at sections of the furnace are shown on the chart.

Boilers and Furnace.

The type of furnace shown in Fig. 1 is usually constructed with a waste heat boiler. The furnace metal charge absorbing 10 per cent of the heat from burning fuel, approximately 10 per cent of the heat is lost by radiation from furnace walls, and 80 per cent remains in the hot gases that pass to the waste heat boiler or

TABLE I — RATES OF COMBUSTION PER CU. FT. OF FURNACE VOLUMES OF VARIOUS TYPES

Type	Lbs. Coal Burned per cu. ft. per hr.	Btu's. per cu. ft. per hr.	Per Cent Efficiency	Per Cent CO.	Per Cent CO.
Average boiler furnace.....	1 to 2	13,000 to 26,000	65 to 83	13 to 15	0 to 0.2
Water wall furnace Sherman Creek.....	1.9 to 3.7	21,000 to 46,000	62 to 83	13 to 15	0 to 0.3
Water wall furnace Bettington boiler.....	2 to 5.4	22,000 to 70,000	66 to 80	10 to 11	
Locomotive boilers water wall.....	5 to 12	60,000 to 140,000	66		
Cannon boiler	16.9	225,280		15.65	.0
Forge furnace, welding temperature.....	17 to 25	230,000 to 330,000			
Railway Materials Co. furnace—special....	30 to 40	400,000 to 540,000			

stack. The waste furnace gas containing 80 per cent of the heat have a temperature well above that of the fusion point of the ash, keeping the ash in the liquid state. The chief difficulty from this source has been the solidifying of the ash in flue or boiler tubes. That gradually closes the stack opening, obstructing the draft.

The use of a water ring forming a short flue, placed at the outlet near the furnace, through which the gas passes, improves this condition. The molten ash passing through this cooling zone (approximately 24 to 30 inches long), gives up its latent heat by radiation to the water ring which is usually made as a part to the boiler.

Comparison of the rate of combustion per cu. ft. of reheating furnace with boiler and the modern boiler furnace:

It will be seen from Fig. 2 that the rolling mill furnace burning 3.7 lbs. of coal per cu. ft. per hour is only one-half the size of a modern boiler furnace burning the like amount of fuel (Table I).

Also, that the combustion is practically completed

at a point in the furnace burning 6.25 lbs. of coal per cu. ft. per hour. If the furnace gases were released to a boiler at that point, the combustion space or furnace would then have a volume approximately 1/3 the value of modern boiler furnaces.

Practical Deductions.

(a) From the data shown in the chart, Fig. 2, may be used for proportioning the combustion space when designing reheating furnaces. If the rate of heat absorption by metal is known, the furnace cross-section can easily be arrived at.

(b) Reheating furnace equipped with waste heat boilers will utilize 70 per cent the total heat in full.

(c) Reheating furnace without waste heat boiler with gases going out the chimney, only 10 per cent of the total heat is absorbed in metal charge.

(d) If the modern boiler furnace were studied in a similar manner it is thought that such investigations would point out a practical method whereby the pulverized fuel can be burned at high rates of combustion per cu. ft. of furnace per hour.

Recent Elections to British I. & S. Institute

William Hastings, Bassett, Jr., Technical Supervisor, the American Brass Company, Ansonia Branch, Ansonia, Conn.

John Henry Calbeck, Director of Research, the Eagle-Picher Lead Company, Joplin, Missouri.

Prof. William Campbell, Ph.D., Sc.D., M.A., Howe Professor of Metallurgy, School of Mines, Columbia University, New York City.

Frederick S. Chase, President, Chase Companies, Inc., Waterbury, Conn.

Howard H. Oraver, Manager, Chemical Dept., Pittsburgh Testing Laboratory, Stevenson and Locust streets, Pittsburgh, Pa.

Launcelot A. Danse, Metallurgist, Cadillac Motor Car Company, 2930 Pingree Avenue, Detroit, Mich.

Carl F. Dietz, President and General Manager, Bridgeport Brass Company, Bridgeport, Conn.

Edgar Hutton, Dix, Jr., M.E., M.M.E., Metallurgist, Research Bureau, Aluminum Company of America, New Kensington, Pa.

James Francis Donnelly, Metallurgist, A. Schrader's Son, Inc., 470 Vanderbilt Avenue, Brooklyn, N. Y.

Hermann L. Greene, Chief Metallurgist, Willys-Overland Company, Toledo, Ohio.

William Allen Hamor, Assistant Director, Mellon Institute of Industrial Research, Thackery and O'Hara Streets, Pittsburgh, Pa.

Charles Ruffin Hook, Vice President and General Manager, American Rolling Mill Company, Middletown, Ohio.

H. Kriegshheim, President, the Permutit Company, 440 4th Avenue, New York City.

Daniel H. Meloche, Metallurgist, Holley Carburetor Company, 2490 Hazelwood Avenue, Detroit, Mich.

Fritz Nicholas Meyer, S.B., Technical Supervisor, Waterbury Branch, American Brass Company, 170 Plaza Avenue, Waterbury, Conn.

Harold Harmond Richardson, M.S., Metallurgist, Aluminum Company of America, New Kensington, Pa.

Robert Jay Shoemaker, B.S., Metallurgical Engineer, Magnus Co., Inc., 303 Railway Exchange, Chicago, Ill.

Anthony J. Smith, Asst. Metallurgist, Packard Motor Car Company, Detroit, Mich.

Frank Newman Speller, B.A.Sc., D.Sc., Metallurgical Engineer, National Tube Company, Frick Bldg., Pittsburgh, Pa.

Ewart Stanley Taylerson, Metallurgical Engineer, American Sheet and Tinplate Company, Frick Bldg., Pittsburgh, Pa.

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CURRENT REVIEW

"Handling Exceptions"

Charles Piez of Chicago Hits the Nail on the Head with His
"Test of Management"

THE man who carries the burden of directing the activities of a large manufacturing or business organization cannot load himself up with detail work. He must delegate it all to subordinates and reserve for himself only the making of decisions affecting the policies of the enterprise. In my 35 years'

products manufactured have a wide application in many branches of industry, and the raw materials are drawn from sources the output of which fluctuates considerably, with a resultant effect on prices. Both our market and our supply, then, are matters which constantly require a great deal of attention, in addi-



CHARLES F. PIEZ

experience with the Link-Belt Company, I have found that modern management is built upon what I choose to call the "exception" plan.

The Link-Belt Company maintains 25 sales offices and nine manufacturing plants in various parts of the United States. The capitalization is \$15,000,000 and the total pay-roll has some 5,000 names on it. The

tion to the usual production problems common to all manufacturing organizations.

Should Consider Such an Arrangement Very Inefficient.

To the small manufacturer who is staying nights at the office worrying out plans for the guidance of a

business employing 50 to 75 men, and who views with dismay the ever-growing accumulation of matters he personally must attend to, the task of guiding the course of a \$15,000,000 concern might seem overwhelming — not to be accomplished except by killing hours and superhuman effort. It might seem reasonable that the head of such a corporation should have to arrange his work so that not a second would be lost at any hour of the day.

But, as a matter of fact, I do not arrange my working day in such a manner, I should consider such an arrangement very inefficient, except in emergencies. The scheduled working day—so much time for planning, so much for dictation, so much for conferences—is very desirable for the subordinate executive whose duties are of a constantly recurring type. But I have found that such a thing is not desirable for the executive who must set a course for the business ship, and hold the craft to it.

It is true that when I was head of the Emergency Fleet Corporation during the war, I worked from 10 to 12 hours a day over a period of two years with hardly a Sunday off. I would not do that under ordinary circumstances, and it would not have been necessary then, had we not been compelled to build a large organization within a short time.

According to my experience, seven or eight hours constitutes a reasonable working day for an executive charged with heavy responsibility. The man who has continually to work overtime or to take work home with him is a poor executive. Any reduction in the pay-roll resulting thereby is counterbalanced many times by the loss of his own efficiency from the standpoint of guiding and settling policies. He is doing a lot of detail work he should train others to do.

Our men who are on the up-grade are taught that while their earlier jobs may consist of the constant repetition of certain duties which they attend to personally, when they get in charge of a plant they are expected to direct others how to do the work, and then to see that it is done that way. They are not to narrow their own field of vision with a lot of detail work. No man can steer who cannot see the whole horizon.

An executive burdened with such duties, I have found, cannot drop a certain line of thought on the stroke of the clock and turn his attention to another line. At least, I have not been able to do it effectively myself, nor have the men who are working with me in the higher executive posts.

As soon as a task crops up which must be repeated again and again, it is time to pass it on to a man who can specialize on it and become expert. That is the test by which I have found it best to delegate work. Does the task present itself often enough that another man can be taught how to do it?

So, by passing on to others the constantly recurring operations of the sort which keep the heads of so many companies in the office late at night, I have been able to leave my own time free from the necessity of scheduling my work. Except in emergencies, there is no rush and bustle in my office. I do not want rush and bustle there. I have found that the particular type of work which is reserved for my own efforts cannot be performed efficiently in such an atmosphere. This

would hold good whether this organization were a \$15,000,000 or a \$15,000 concern.

My experience has indicated that the larger the organization gets, the more the duties of the chief executive partake of a teaching or coaching character, combined with that of charting a course through the broad field of business. All of these duties together, do not involve any detail work on my part. But they do involve a great deal of thought, of study, or contemplation, and—if I may use the word in a non-trivial sense—of dreaming.

This atmosphere of quietude in the head office is necessary to efficient management. Without it the man in charge could not concentrate well, nor could he make unhurried decisions. When an error is made in the guidance of a \$15,000,000 organization, the loss is usually large enough to make one pause. Our decisions must be thought over several days if necessary. And if the business were only a fraction of its present size I should still feel that the same method of arriving at them would be necessary.

My Own Desk Is Rarely Clear of Papers.

However, my own working day is far from a leisure period. I have no time for golf during the week. Keeping in touch with general conditions as they affect our business is a task in itself. Also, there are problems submitted by the vice-presidents in charge of plants. When a higher executive of the organization encounters a problem of policy upon which he feels the need of advice, it is my work to advise with him. Naturally, a matter of this sort is likely to come up at any time, and it must be considered at the time it arises.

My own desk is rarely clear of papers. I could probably keep it so by passing to others a great many things which are brought to my attention, but I would not feel comfortable in so doing. I want before me all matters which give information as to the condition of our organization from the financial, marketing, or production standpoint. And papers with this information must be studied constantly.

It sometimes happens, too, that large customers call at the head offices of our organization for conferences on their orders. When these involve matters of policy, the burden of decision falls upon me. Again, salesmen of high caliber come around with ideas that are worth while from the policy standpoint, and if I think they have anything that may be of use to us in a broad way, I usually see them.

There is the additional consideration that in my capacity of coach I may be called at any moment to some distant part of our organization to assist in deciding a question of financial, marketing, or purchasing policy. In times when prices are uncertain and the market of most raw materials is falling, these calls are likely to come with greater frequency than at other times. Were we doing business in a rising market with lots of orders coming in, and no danger of financial or administrative uncertainties in any of our plants, my services would hardly be needed at all. The purely operative functions of our organization are worked out so that they can be administered by the plant managers without calling me in.

(Concluded on page 165.)

Short Digests of Foreign Articles

By ALBERT P. SACHS*

STAHL UND EISEN contains an article by Ad. Fry of Essen on "Optical Temperature Measurements in the Plant," which is of general interest. Thermoelectric pyrometers and water pyrometers are satisfactory to about 1200 deg. C., but the protective tubes have only a short life, so that the effective upper limit is 1200 deg. C. (about 2200 deg. F.) Above this optical pyrometers must be used, even for lower temperatures in the case of moving bodies such as occur in rolling, forging and pouring. For these purposes optical pyrometers and radiation pyrometers must be used. The fundamental bases of the theory of optical temperature measurements are simple and are founded on the laws of black body radiation. Various bodies with different coefficients of emissivity or absorption (which are equal) have different brightnesses at the same temperature, necessitating corrections in practice. The radiation reflected from glowing surroundings also introduces a disturbing factor. But it happens (conveniently!) that if the object and the furnace are at the same practically uniform distributed temperature, the radiation of the body plus its reflected radiation is that of a black body at the same temperature and can be read off without corrections. In pouring molten metals it has been found that the brightest part of the flow, made so by radiation and reflection from the adjacent parts, has approximately the equivalent black body radiation. Curves are given showing corrections to be made for iron, steel, high speed steel, cast iron with and without oxide coatings; also lead baths, stainless steel, fused salts, slags, fused oxides, etc.

The influence of manganese content on the hydraulic properties of blast furnace slags is the subject of another article. It is shown, as is well known, that manganese affects the hydraulicity of slags adversely, and that the removal of manganese from these identical slags (in an electrical furnace) improves them. Photomicrographs show the mode of occurrence of manganese in these slags. The silicates and aluminates which are of importance in forming blast furnace slags were compared with and without manganese present and it was shown that they were rendered poorer in their hydraulic hardening power by the presence of manganese. It is also shown that on crystallization the manganese separates slightly in the silicates and more strongly in the aluminates. In the granulation both of slags and of synthetic melts the manganese remains dissolved with a yellow coloration.

The *Giesserei Zeitung* has an article on the "Cast Iron Diagram." There is an elucidation of the cast iron diagram, by means of which a cast iron can be produced which is to the maximum degree attainable independent of the cooling procedure; it shows a pearlitic ground mass of fine texture and has remarkable denseness.

Utilization of galvanized iron is the subject of an article. Zinc can be recovered in the Martin furnace without previous pickling. In the passages before the draft fan the material is very coarse and impure (40 to 60 per cent zinc) and is sold to zinc refiners; but be-

yond the exhaust fan the zinc oxide is finer and purer and goes to the color manufacturers.

An article on the "Mass Production of Locomotive Cylinders and Other Locomotive Castings" is liberally illustrated with photographs to show approved methods.

The *Chemical Age* (London) in its metallurgical section gives figures on a research carried out at the Hagondange Steel Works to determine heat losses in metal mixers. The pig iron was basic and the metal mixer was a hydraulically tipping cylindrical vessel of 1100 tons capacity. The heat balance established was based on the known temperature of molten metal before and after passing through the mixer. The pig ladles were of 12-15 tons capacity, and traveled 300 to 800 meters from the furnaces into which they were poured after slag was skimmed and after they were hoisted a vertical distance of about 15 meters. The ladles were weighed before and after pouring. The metal which was withdrawn from the mixer (which was fired by unheated coke oven gases) was similarly checked and weighed. The gas supply was metered. The mixer lining was silica brick covered with magnesia brick. The average supply of pig iron to the mixer was 600 to 800 tons per 24-hour day. Investigations were made for 59 consecutive days. The average temperature of the entering metal was 1353 deg. C., and of the metal taken out for the steel converters was 1278 deg. C., giving an overall loss of 74 deg. C., which agrees well with the theoretical requirements established by the balance sheet, and shows the mixer not to be inefficient.

The *Zeitschrift für angewandte Chemie* has an article on "The Problem of the Corrosion of Metals," by E. Maass and E. Liebreich of the Chemisch-Technische Reichsanstalt, Division of Metallurgical Chemistry and Metal Protection. They bring out the fact that tests are generally made with specimens free from electric influence, whereas, in practice, the metals are actually under the influence of stray currents, currents due to differences in pressure or tension or to contact with other metals or with alloys of other compositions and that metals thus become cathodically or anodically polarized. The latter generally leads to corrosion as does also weak cathodic polarization. The currents though small have a long time factor. The avoidance of or protection against these weak currents is in practice impossible. Two methods of protection are the best of those available. The first is covering with protective films, metallic or organic (paints), but this is temporary at the best, and frequently is not resistant enough. The other method is to alloy it with other metals so as to "ennoble" it electrochemically so that the new alloy has such a small solution tension as practically not to go into solution at all. This method has been achieved in chrome and chrome-nickel steels at a price. Of course, physical properties (hardness, etc.) are altered simultaneously also, and introduce new difficulties of their own.

At a meeting of the London Section of the Society of Chemical Industry on December 1 the subject of discussion was "Protective Paint Coatings." Sir Robert Hadfield summarized the theories of corrosion and noted especially the properties of alloying metals. The chromium iron alloys show about 10 times the resistance to atmospheric corrosion by the atmosphere of Sheffield that the purest ingot iron does. In Shef-

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field tap water the loss in weight per unit area of the chromium alloy was under one-eightieth that sustained by the ingot iron. Dr. Morrell discussed varnish films for metals and showed that the only possibility of maintaining varnish and paint as metal protective coatings would be to provide coatings which would not crack on exposure and were of very low water absorbing properties, and moreover, did not allow metallic iron to pass through them, although they might allow water to pass.

The following books may prove of interest to our readers:

"Investigation to Clarify Question of Electrical Smelting of Swiss Iron Ores"; 48 pages; published by Verlag Stahleisen, Dusseldorf, 1924. The electrical conductivity of ore, coke and charcoal is considered. Coke is the best conductor of these by far, although electrode carbon is still better. Practical tests were made with iron ores from Gonzen and Fricktal. These tests show that electric smelting of iron ores with high sulphur or silica is especially advantageous.

"History of Iron" (in German) under the editorship of Dr. Otto Johanssen is really a joint product of the Association of German Ironmasters.

"General Profile (Shapes) Specifications of the German Steel Rolling Mills" was published in 1924 in its third edition in three languages (German, English and French) and has 218 pages.

The Proposed European Steel Trust

By A. C. BLACKALL

THE new condition of affairs in the Ruhr and the comparatively free attitude Germany can once again adopt are factors that must make themselves felt throughout the whole of continental Europe and, in fact, throughout the world. Particularly is this the case with regard to the iron and steel industry.

The endeavor to form a gigantic steel trust is still in the balance. A special Berlin correspondent of the London "Times" writes: "Negotiations for the establishment of a new German steel syndicate have been started. About 90 per cent of the producers, including all the principal works, are in favor of it and in agreement with the proposal to fix definite contingents for production in order to regulate supply in accordance with demand. The syndicate would not, however, see the product of its members. The formation of the steel syndicate will probably be followed by the re-establishment of syndicates in other branches of the iron industry and will assist the Belgian industrialists in their endeavors to form a European steel syndicate."

On the same subject a recent issue of the "Koelnische Zeitung" says: "Before the Franco-German commercial negotiations, due for renewal on November 5, a complete understanding will probably have been arranged between the Comité des Forges and the Ruhr ironmasters. Should the negotiations reach this result, a commercial treaty, which was expected to be obstructed by so many difficulties, would follow as a matter of course, and we should have something in the nature of a gigantic Franco-German steel trust."

According to the paper quoted, invitations to join this combination were sent out to the heavy industry of all the chief iron-making countries of Europe, but only Luxembourg, whose heavy industry is dominated by French and Belgian capital, and Sweden accepted. Belgium has not yet replied, and Great Britain has refused to come in on the conditions offered.

Herr Stressemann's paper comments at considerable length on the statements of the Koelnische, and argues that they are probably premature, and that in any case the co-operation of the various partners in the trust would not amount to more than an apportionment of output to avoid the consequences of the present over-production of steel. The writer points out that France has at present an annual raw iron production capacity of 11,000,000 tons, an actual output of 7,500,000 tons, and a consumption of only 5,000,000 to 5,500,000 tons. She is, therefore, compelled to either restrict production and thus suffer a heavy capital loss, or to widen her foreign markets, either by political pressure or by commercial agreements. For the failure of England to join the combine the writer finds two reasons. One of these, he says, is the reluctance to agree to the partitioning of the South American, and perhaps also, of the South African market. The other is the demand of the English ironmasters that the import of half-finished products to Great Britain should be reduced considerably below the present level.

Referring to these reports, the Berlin correspondent to the London "Daily Telegraph", telegraphed:

"The news published by the Koelnische will come as a severe blow to certain British politicians and functionaries, who have been comforting themselves with the idea that the inclusion of our country in a great Continental Steel Trust would largely discount the danger threatened to our industry from Germany's perfected manufacturing apparatus.

This subject has caused considerable comment in Paris, and the special Paris correspondent of the same paper, under date of November 1, telegraphed:

"Important negotiations, it appears, are proceeding between representatives of the French and German metallurgical interests, with the object, it is said, of forming an immense steel trust. The first published news came here in the form of a telegram from the 'Vossische Zeitung' in Berlin to the effect that a complete agreement was about to be reached between M. de Wendel, representing the French Comité des Forges and Herren Thyssen and Voedler on behalf of the Ruhr group. The 'Matin' today announces from Wiesbaden that the news of the negotiations, which, hitherto carried on in Berlin, are about to be transferred to Paris, has aroused the greatest interest in the Rhineland. Their object is said to be the linking up of the French and German metallurgical industries, the delimitation of the zones of export, and the establishment of international agreements. No mention is made in the Matin of any offer of collaboration to other countries, which, according to the 'Vossische Zeitung', has been refused by England and accepted by Luxembourg and Sweden. The Franco-German conference for a commercial treaty is due to be resumed here in a day or two. If the proposals for a metallurgical agreement are proceeding as favorably as is reported the chances that the official negotiations between the two countries will go smoothly towards a successful issue will be enormously increased."

The "Daily Telegraph" a few days later discussed the subject in its editorial columns. An extract of this article follows:

"British iron and steel manufacturers and merchants are awaiting with keen interest the development of the negotiations progressing between the ironmasters of France and the Ruhr, which, it has been stated, have as their object an understanding for operating the industry in the immediate future. Various conjectures are being indulged in as to the precise nature of the projected combination, but there seems to be a general disinclination to believe that anything like a gigantic Franco-German steel trust is about to be established. According to accounts given in German quarters, British ironmasters declined an invitation to join in an international combine, but a high authority, who is in most intimate touch with the iron and steel trades of this country, as well as those of the Continent, assured a representative that, so far as he was aware, no formal invitation of the kind had ever been received here.

As is well known, this industry is in a very bad way just now in the European countries, and it is certain that there have been discussions with a view to devising some scheme to deal with the problems of over-production, ruinous price-cutting, and the generally unremunerative carrying on of works; but there are differences of opinion as to the exact nature or scope that any international understanding ought to assume. Unless production is to be restricted—with resultant capital loss—foreign markets must be widened, and obviously the partitioning of certain foreign markets opens out a question bristling with difficulties. Few of those competent to judge the situation and the prospects think that any organization which might be correctly termed an international trust will be set up and many consider that no great combine between French and German interests, such as that reported to be on the eve of accomplishment, will arise out of the present negotiations. It would come as a great surprise to those acquainted with the conditions of the industry in the two nations if the Comité des Forges and the Ruhr ironmasters should find it possible to organize a trust in the sense of which that designation is understood in America."

Sir William J. Larke, director of the National Iron and Steel Manufacturers, said in an interview: "As to the effects of any combination between French and German iron and steel interests, a number of the works which are now, by virtue of the Treaty of Versailles, transferred from German to French ownership, form part of a complete economic unit with works in other parts of Germany. The only difference from pre-war conditions, therefore, is that such a combination might involve other works controlled by French interests than those particularly referred to. On the other hand, it is clear that economic pressure alone must bring about an understanding, having for its object the revival of pre-war conditions; otherwise the Lorraine works would have to find new outlets for their products. This will involve a still further increased competition in neutral and other markets than that arising from the increased productive capacity of the world. Consequently the effects of such a combination in this particular, if it only re-establishes pre-war conditions, is not likely to react unfavorably on the future of British industry."

The first step towards an industrial revival would seem to be the restoration of pre-war relationships between producers and consumers as being the line of development having the least resistance. Further, if such a combination brings about economic industrial stability in the countries concerned, this in itself must react favorably on British industry.

There is widespread evidence of a belief among iron and steel masters that the carrying into effect of the Dawes Report will very materially assist the industry, not only in Germany, but in other European countries to recover itself. The French and the Ruhr concerns must, of course, play a leading role in the revival, and some form of collaboration must obviously be necessary. But the question of a gigantic European trust is another matter.

As a matter of fact, reports are of a highly conflicting nature. An important consideration is that it is as yet too early for the recent change in political conditions in England to have made itself felt. The strength of the Conservative party, however, is overwhelmingly great, and, since the vast bulk of the British iron and steel industry is controlled by that party's adherents, it can be predicted with a certain amount of confidence that some definite arrangement is likely to be arrived at. The success of the German loan, the improved tone of foreign exchanges generally, and the hopeful feeling that under the new aegis this country is likely to settle down to steady work, with the earnest desire to live and let live, are all factors which should materially assist the straightening out of any difficulties that may exist.

Technical Articles

Spring Steel from Cold-Rolled Strip Mills — Frequent Annealing Needed Between Passes — Plant of Wallace Barnes Company, with Unique Warehousing Arrangement, Unusually Flexible.

Making Steel Castings Stronger — Effect of Nickel, Chromium and Other Alloys in the Heat-Treated Product — Application in Railroad, Mining, Rolling Mill and Motor Fields.

Proposed Hearth and Bosh Construction -- Modern Ideas Applied to Blast Furnace Design for Highest Combustion Efficiency — Elliptical or Similar Section Favored.

Manufacture and Uses of Stainless Iron — Hamilton-Evans Direct Process Described—Cost and Physical Properties—Heat Treatment, Rolling and Forging.

Rolling Mill Electric Operation — Compilation of Main Roll Drives in the United States and Canada by Class of Mill and Type of Connection — More Than 1,300,000 Hp.

Soda Ash as Desulphurizer.

Annealing Malleable Cast Iron.

Refractory Problems in the Foundry — Brick for Cupolas, Malleable Furnace and the Open-Hearth Discussed at a Symposium of the American Ceramic Society.

Ingot Soaking Pits Heated Electrically — Reduced Scale Loss — Comparisons with Fuel Heating on Energy Required, Including Rolling Process — Space Required.

(Concluded on page 176.)

Current Literature on Ferrous Metallurgy

By E. H. McCLELLAND*

Alpine-Montan, Austria's steel producer. B. F. Castle. *Iron Age*, v. 115, Feb. 5, 1925, p. 404-407.

Ingot capacity, 550,000 tons annually.

An analysis of defective castings. E. Longden. *Metal Ind. (London)*, v. 26, Feb. 27, 1925, p. 215-217. Serial.

Annealing malleable cast iron; test to determine the effect of rapid heating; some quick results under special conditions. S. J. Felton. *Iron Age*, v. 115, Feb. 12, 1925, p. 489-490.

Are porous castings caused by gates and risers? Howard Miller. *Foundry*, v. 53, Mar. 1, 1925, p. 180.

Release of absorbed gases by bottom pouring without gates or risers.

Better foundry pattern storage advocated. *Iron Age*, v. 115, Feb. 19, 1925, p. 551-553.

Bibliography of manganese steel. E. H. McClelland. *Forging*, v. 11, Feb. 1925, p. 49-53.

Breiten beim walzen. W. Tafel and H. Sedlaczek. *Stahl u. Eisen*, v. 45, Feb. 5, 1925, p. 190-193.

British blast-furnace graps. *Iron and Coal Trades Rev.*, v. 110, Feb. 6, 1925, p. 219.

Curves showing furnaces in blast, 1912-1924; and production, 1920-1924.

Charge cupolas mechanically; handling pig iron scrap, and limestone is facilitated by mechanical equipment from unloading the cars to charging the cupola in Ohio shop. *Foundry*, v. 53, Feb. 1, 1925, p. 111-113.

Continuous rolling mill. L. D. Whitehead. *Iron and Coal Trades Rev.*, v. 110, Feb. 6-13, 1925, p. 211-213, 252-254.

Controlling gray iron qualities. James Ward. *Foundry*, v. 53, Mar. 1, 1925, p. 186-188.

Conveyance of material in the foundry. J. M. Primrose. *Foundry Trade J.*, v. 31, Feb. 26, 1925, p. 188-189.

Cost of atomizing fuel oil; a comparison of the cost of atomizing fuel oil with five types of apparatus. Chaplin Tyler. *Chem. and Met.*, v. 32, Feb. 23, 1925, p. 323.

Cost trends in manufacturing. Lewis H. Haney. *Iron Age*, v. 115, Feb. 5, 1925, p. 414-415.

Ratio of payrolls to value of iron and steel products.

Cost trends in manufacturing. Lewis H. Haney. *Iron Age*, v. 115, Mar. 12, 1925, p. 778, 781.

Relative decline in labor cost.

Dispelling drudgery in the hot mill. John D. Knox. *Iron Trade*, v. 76, Feb. 19, 1925, p. 503-506, 543.

Distribution of rolled steel by states. *Iron Age*, v. 115, Feb. 19, 1925, p. 539-550.

The first attempt to present comprehensive statistics of regional steel consumption. Shows distribution of shipments of leading manufacturers, by type of product.

Electric soaking pits. T. F. Baily. *Iron Age*, v. 115, Feb. 12, 1925, p. 482.

Fireproofing of structural steel; basic principles in heat expansion and heat conductivity govern; suggested construction details for security. A. W. Sinnamon. *Iron Age*, v. 115, Mar. 5, 1925, p. 694-696.

Foundry maintenance and flask storage. *Iron Age*, v. 115, Mar. 5, 1925, p. 691-692.

French and American iron foundry methods compared. William Ruddy. *Foundry*, v. 53, Feb. 1, 1925, p. 97-99.

Future improvement of cast iron. J. G. Pearce. *Foundry Trade J.*, v. 31, Feb. 26, 1925, p. 181-184.

Gear drive for steel mills. *Iron and Coal Trades Rev.*, v. 110, Feb. 13, 1925, p. 269.

For sheet mills.

Gegenwärtige stand des verbandswesens in der deutschen eisen- und stahlindustrie. Bruno Bruhn. *Stahl u. Eisen*, v. 45, Feb. 5, 1925, p. 177-180.

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Graphiteutektikum im gusseisen. Emil Schütz. *Stahl u. Eisen*, v. 45, Jan. 29, 1925, p. 144-147.

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Iron and other metals for ingot molds; influence of certain thermochemical factors; analyses of metal used; special alloys for molds. J. H. Hruska. *Iron Age*, v. 115, Jan. 29, 1925, p. 341-342.

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No. 33 in a series of interesting articles briefly outlining special industries.

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Magnetic and physical hardness; variations in alloy steels caused by different quenching media; possible solution of an unsolved problem. John A. Mathews. *Iron Age*, v. 115, Mar. 5, 1925, p. 689-690, 735.

Part of Henry M. Howe memorial lecture before A. I. M. and M. E.

*Technology Librarian, Carnegie Library, Pittsburgh.

Making hard manganese steel involves careful treatment. Hubert Hermanns and Hermann Meixner. *Iron Trade*, v. 76, Feb. 12-19, 1925, p. 452-454, 509-511.

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Valuable article with foot-note references to additional literature. Discusses metallurgical and foundry problems, nickel, chromium and other alloying elements, and applications of castings.

Manufacture and uses of stainless steel. H. S. Primrose. *Iron Age*, v. 115, Feb. 12, 1925, p. 479-481.

Hamilton-Evans direct process.

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Methods of metal melting. *Iron and Coal Trades Rev.*, v. 110, Feb. 6, 1925, p. 222.

Neuere koksofenbauarten. Oswald Peischer. *Stahl u. Eisen*, v. 45, Feb. 12, 1925, p. 224-231.

New coke-oven types; carbonising capacity, temperature distribution and heat consumption. Oswald Peischer. *Iron and Coal Trades Rev.*, v. 110, Feb. 13, 1925, p. 249-251.

Similar to the preceding German article, with some of the same illustrations.

New non-corrosive alloy of copper and silicon. *Iron Age*, v. 115, Feb. 5, 1925, p. 412.

Brief notice regarding "Everdur" developed by Du Pont Engineering Co., Wilmington, Del.

New type of crucible melting plant. *Foundry Trade J.*, v. 31, Feb. 26, 1925, p. 190.

Obviating porosity in grey-iron castings. F. C. Edwards. *Metal Ind. (London)*, v. 26, Feb. 6, 1925, p. 139-141.

Properties and uses of alloy steels; compilation covering effects in heat-treated condition; their manufacture and relative advantages and disadvantages. R. H. Aborn. *Iron Age*, v. 115, Mar. 5, 1925, p. 685-687.

Proposed hearth and bosh construction; modern ideas applied to blast furnace design for highest combustion efficiency; elliptical or similar section favored. S. P. Kinney and Fraser B. McKenzie. *Iron Age*, v. 115, Feb. 12, 1925, p. 476-478.

Includes diagrams showing advantages.

Rolling mill electric operation; compilation of main roll drives in the United States and Canada by class of mill and type of connection; more than 1,300,000 Hp. represented. *Iron Age*, v. 115, Feb. 12, 1925, p. 488-489.

Secures uniformity in ladle iron; New England producer of old-fashioned gun iron equips waste heat boiler and reverberatory-type melting furnaces with pulverized coal system; operating advantages are gained. H. R. Simonds. *Iron Trade*, v. 76, Mar. 5, 1925, p. 628-630.

Soda ash as desulphurizer in foundry. *Iron Age*, v. 115, Feb. 12, 1925, p. 473-474.

The same. *Foundry Trade J.*, v. 31, Feb. 26, 1925, p. 174-175.

Treatment beneficial; does not aid strength, but conserves manganese.

Sonderregelung der arbeitszeit in den kokereien und hochofenwerken. E. Hoff. *Stahl u. Eisen*, v. 45, Feb. 12, 1925, p. 231-235.

Spring steel from cold-roll strip mills; frequent annealing needed between passes. *Iron Age*, v. 115, Feb. 5, 1925, p. 399-402.

Standardization of product aids handling; uniform containers advocated as further step toward lower material handling costs; wire mill practice. E. T. Bennington. *Iron Age*, v. 115, Jan. 29, 1925, p. 344-346.

States malleable refractory needs. H. A. Schwartz. *Foundry*, v. 53, p. 203-204.

Steel and light alloys as engineering materials. Leslie Aitchison. *Iron and Coal Trades Rev.*, v. 110, Jan. 30, 1925, p. 174.

Abstract of paper before West of Scotland Iron and Steel Institute.

Steel consumption of individual states. *Iron Age*, v. 115, Feb. 26, 1925, p. 609-610.

East makes three-fourths of steel and uses less than one-half.

Steel crystals. *Metal Ind. (London)*, v. 26, Feb. 20, 1925, p. 187-189.

Discusses formation and describes and illustrates crystal 19 inches long, probably the largest ever produced.

Structural composition of cast iron. Arthur Logan. *Metal Ind. (London)*, v. 26, Feb. 13-27, 1925, p. 163-165, 189-192, 218.

Transportmittel und transportwege der rohstoffe des Ruhrorter Hochofenwerkes der Phoenix-Akt.-Ges. H. Leiber. *Stahl u. Eisen*, v. 45, Feb. 5, 1925, p. 182-189.

Ueber den einfluss des sauerstoffs auf die physikalischen und technischen eigenschaften des flusseisens. A. Wimmer. *Stahl u. Eisen*, v. 45, Jan. 15, 1925, p. 73-79.

Untersuchungen über technisches ferrosilizium. M. Bamberger, O. Einerl and J. Nussbaum. *Stahl u. Eisen*, v. 45, Jan. 29, 1925, p. 141-144.

Valuation of coal for blast furnaces. Edwin H. Lewis. *Iron and Coal Trades Rev.*, v. 110, Jan. 30, 1925, p. 170.

Abstract of paper before West of Scotland Iron and Steel Institute.

Verformen und rekristallisieren; theoretische betrachtungen zur kaltverarbeitung der metalle. Friedrich Körber. *Stahl u. Eisen*, v. 45, Feb. 12, 1925, p. 217-223.

Wege und ziele zur veredelung von gusseisen. P. Goerens. *Stahl u. Eisen*, v. 45, Jan. 29, 1925, p. 137-140.

World's pig iron and steel output. Edwin F. Cone. *Iron Age*, v. 115, Jan. 29, 1925, p. 331-333.

Graphic and tabulated statistics of the six leading countries comparing 1912-1913 with 1919-1924. Includes exports.

Zur kenntnis der primärätzung. P. Oberhoffer. *Stahl u. Eisen*, v. 45, Feb. 12, 1925, p. 223-224.

"Handling Exceptions"

(Continued from page 160.)

Modern management is built up on what may be termed the exception plan. The head of each department, while supervising routine operations, has referred to him for decision everything out of the ordinary, everything, in fact, that the man doing routine work cannot decide. The department head decides as many of these questions as he feels competent to do and passes the more difficult decisions on to his superior.

The executive cannot immerse himself in routine matters, he must hold himself free to take care of the exceptions. He is, in effect, an emergency man, and it would mean death to his usefulness if he made himself the slave of a time-table.—"Factory."

THE SAFETY CRUSADE

New Wire Rope a Safety Aid

This Most Recent Invention Fills a Long Felt Want in Industry

THE first basic change in wire rope construction in more than a century is embodied in what is known as the new Tru-lay rope. The principle developed in the making of the rope is the "preforming" of wires and strands to the exact shape they must have to fit correctly in the completed product. The rope is being made in Lang and regular lays up to one inch in diameter and engineers concerned with its development for general industrial purposes express sat-

The preforming of the wires and strands in the rope results in evenly balancing the load on individual strands and in a remarkably uniform load distribution to single wires. The rope shows no tendency to high strand in actual use and has stood up satisfactorily in winding tests under heavy loads.

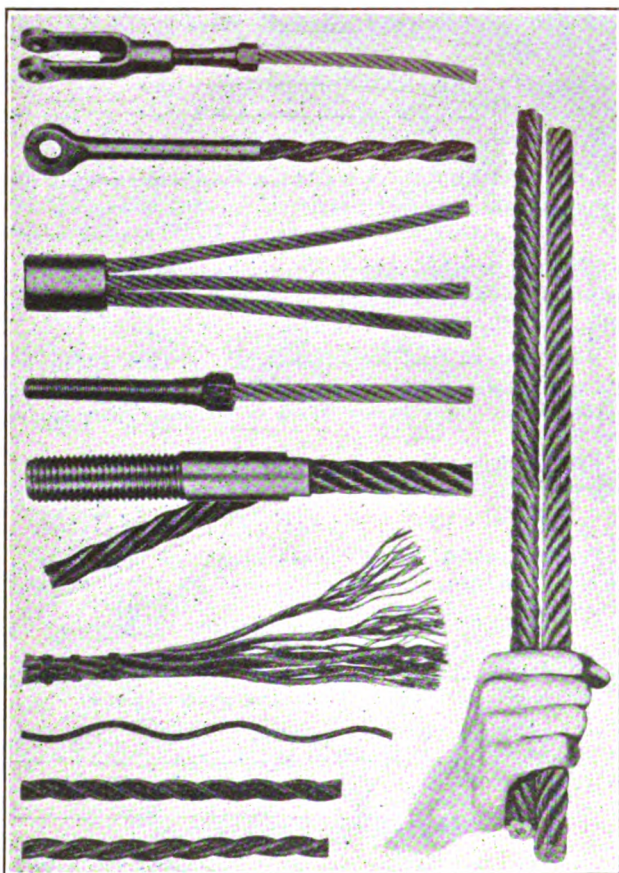
Broken wires in this new rope lie flat. Outer wires on cables, broken by long wear or abrasion, cause considerable trouble, and often necessitate the removal of the rope before it should be discarded. The outer wires of this rope show no tendency to fray out of the rope body. They continue in their places, thus lessening the wear on other wires and on sheaves and drums. The fact that the rope does not unstrand makes splicing a comparatively simple operation.

From the standpoint of safety, industrial engineers who have used Tru-lay rope are particularly commendatory. Rope users have long known that Lang-lay rope has advantages over regular lay for certain sheave and drum work. While 80 per cent of mine cable used in England and Europe is Lang-lay, it has been little used in the United States because of difficulties in splicing and handling. The preformed principle in Tru-lay rope is designed to meet this difficulty, making use of Lang-lay rope possible wherever desired.

To make available practically the entire strength of the new rope, the American Cable Company has developed for it a special steel fitting, without zinc, bearing the trade name Tru-loc. The Tru-loc fitting has not only proved dependable under ordinary conditions, but also permits the use of turnbuckles, shackles and other equipment used with rods and chains.

A steel sleeve is slipped over the smooth unseized end of the rope, placed in a specially designed press, and made to "flow" down upon the rope until it grips wires and strands. These sleeves may be of any reasonable length—can be threaded, can be equipped with heads of various types for wrenches, or furnished with eyes or hooks. The fitting is lighter, less bulky and has been found to be more dependable than the old style zinc socket, probably because of the greater equalization of load on wires and strands.

Tru-lay rope is designed for use in every industry where dependable wire rope is a factor. It is now being introduced in the mid-continent oil fields, in the general building and construction field, in the cement and quarrying fields and in a large variety of factory and shop operations, including elevator and crane operation. In smaller sizes it is considered satisfactory for airplane and airship equipment, and is now used extensively with special fittings in the rigging of coast patrol boats for the United States government.



Various illustrations of new rope embodying safety features — methods of fastening, splicing, etc., and a graphic illustration (at the right) showing how the rope can be cut and handled without seizing and without loss of shape.

isfaction with its performance under exacting and strenuous tests.

An important characteristic of the Tru-lay rope is that it resists unstranding. It can be cut at any point for splicing and otherwise handled without the necessity of seizing. Exhaustive tests show that it has considerably longer life than ordinary rope under reversed bending stresses—an important asset where winding over sheaves and drums is a chief cause of wear.

Rolling Rails—History*

A Series of Pictorial Sketches Showing the Gradual Growth of Design to 1857

By G. T. RAIDABAUGH†

PART II.

THE Fig. 17 (next page) is a full size cross section of the first wrought iron edge rail. This rail was rolled at some time between the years 1820 and 1825. The first notice we find of its use was on the Stockton and Darlington Railroad. This road was opened for general traffic September, 1825.

No. 1—The rail. No. 2—A reduced section showing manner of securing the rail in the track. A—cast iron chair, B—hole through cheeks of chair and rail through which a pin is driven to secure the rail in chairs. The chairs were spiked down to stone blocks or sleeper, through holes C—in base of chair.

Some of the early descriptions of this rail show it with the joints between the ends of the rails on an angle of about 60 deg. as dotted lines in No. 2.

In the report of the National Museum for the year 1889, a description of the Birkenshaw rail "the upper surface to be slightly convex to reduce friction, the lower part to rest on supporting blocks, chairs and sleepers; the joints are made with a pin."

By the year 1830, the Birkenshaw rail was changed to the Birkenshaw Fish Bellied rail. These rails were 5 to 18 feet long, divided into three foot fish belly sections as shown in No. 1. The rails were rolled parallel and the metal sheared out to form the fish belly No. 2, showing one half of a fish belly, section and cross sections of the rail at A and B.

When looking up the history of this rail the thought uppermost in my mind was why did they make the rail in this form as they are very difficult to make. From what we learned about them there is no doubt but that the fish-bellied rail came into use through the views held by some of the railway engineers of that day. That a railway should be of equal solidity at all points on the line and as they believed the rail would be stiffer and more unyielding at the joints where they rested in the chairs and were supported upon the stone blocks, for that reason it would be necessary in order to equalize the stiffness of the line. To take some of the metal from the rail at that point W. B. Adams, in a book published in 1862, states "that the fish bellied rails were a mechanical error, that there was a false datum in assuming the sleepers on stone supports to be an unyielding fulcrum instead of a yielding point. This was soon discovered and the rail made parallel again."

In the year 1830 to 1832, the Boston and Lowell Railroad had one track, laid with this rail. One of the original rails laid upon that road with the cast iron chairs and wrought iron wedges for securing the rail in them is in possession of the late Mr. R. K. Wards Estate at Sparrowspoint, Md.

The next rail to come out is known as the Clarence rail. This is also an edge rail and was made as early as 1830. A number of our early American Railroads

were laid with this rail. The Boston and Lowell, one track, Germantown and Norristown and the Allegheny Postage were some of the roads using the rail. The rail here shown full size is taken from a piece of one of the rails used upon the later road. Fig. 19.

We also have a short piece of one of the rails laid down on the Germantown and Norristown road in the year 1831. This rail is said to be an improvement on the Birkenshaw rail as it can be secured in the shoes at chairs without the use of pins at the joints. No. 2 showing the rail and chair, the rail held in a vertical position by the thin iron wedge B; the lower projection on the rail preventing it from lifting. It was later found that the driving of the iron wedges broke a great many of the cast iron shoes. This was remedied by changing the wedge side of the chair to take a wooden wedge about 1¼ in. thick, which soon became the permanent practice. Between the time this rail came out and the year 1840, there were quite a number of designs and modifications of this rail made and used.

The tee rail now in general use is an American invention. The directors of the Camden and Amboy Railroad in September, 1830, instructed Robert L. Stevens, President and Chief Engineer, of that company, to visit England and report upon railroad matters there and directed him to purchase all iron rail, which they preferred to the wooden rail plated with strap iron (see Fig. 14). A short time after Mr. Stevens sailed and during this voyage he designed the first rail with a base, by whittling thin wood in shapes until he finally got one to suit. He was familiar with the English rail and saw that they required expensive chairs to hold them in place, so that they were not adopted to this country where metal workers were scarce and iron dear.

He added the base to the tee rail dispensing with the chairs. He also designed the hook headed spike (which is practically the railroad spike of today) and the tongues B (which has developed into the fish bar.)

The sketch, Fig. 20, shows his first proposed rail, which was to be rolled with the projection A, on the base every 2 feet where they rested upon the supports and the tongue B, on the end of the rail to join them together. However he did not find it practical to roll them with the projection and tongue, so they were omitted as we will see later.

When found that it was not practical to have the rail rolled as first designed the section was changed, and it has been somewhat of a task to determine what the cross section of the first tee rails rolled was like. After a careful study of all the evidence to be obtained at this late day, we believe that one of the two sections shown, Fig. 21, was the first rolled, with preference in favor of section B, as it corresponds more fully to the description of the rail as given by the historians of that day than any other we have found. The Sec. B. conforms very close to a description of the tee rail laid on the Camden and Amboy Railroad, as given in Wood treatise on Railroads Published in 1832 —

*This data is published through the courtesy of the Bethlehem Steel Company, furnished by Joseph Scholl, Roll Superintendent, Wheeling Steel Corporation, Portsmouth, O.

†Sparrows Point, Md.

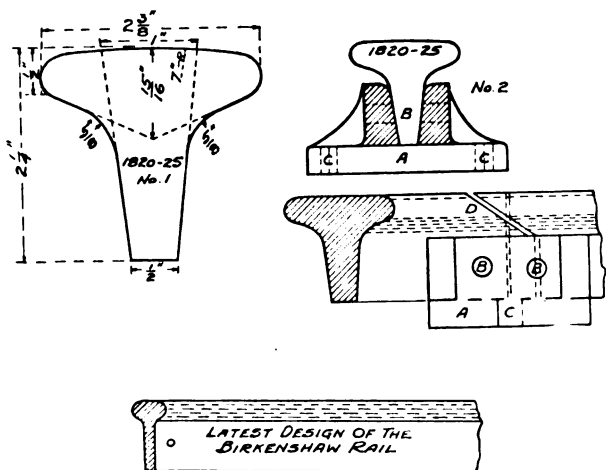


Fig. 17

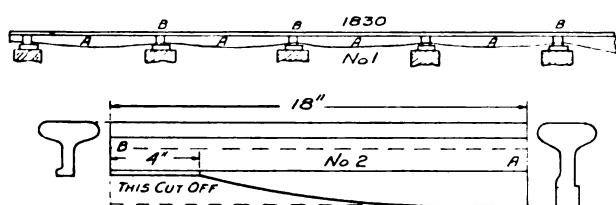


Fig. 18

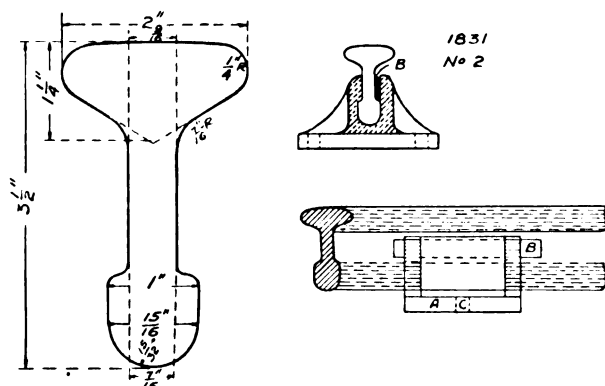


Fig. 19

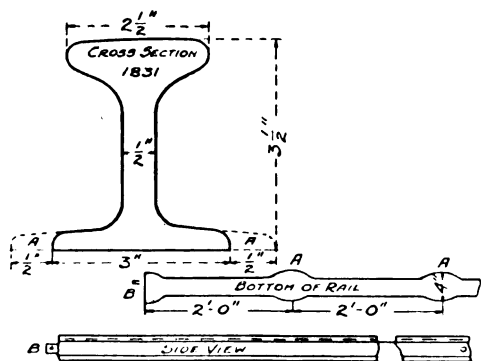


Fig. 20

FIG. 17—Shows full size cross section of first wrought-iron edge rail; method of anchoring, and at bottom, the Birkenshaw rail.

FIG. 18—Shows the Birkenshaw of 1830.

FIG. 19—The Clarence rail, used by early American roads.

FIG. 20—Robert Stevens designed the Tee rail.

"The rails were of rolled iron 16 feet long, $2\frac{1}{8}$ in. thick on top, $3\frac{1}{4}$ in. thick at the bottom, $3\frac{1}{2}$ in. deep, the neck $\frac{1}{2}$ in. thick, the weight, 200 pounds—39.18 pounds per yard."

A section of this rail is at the Pennsylvania Railroad Company's Broad Street Station, Philadelphia, Pa., which is shown in Fig. 22, next page. Section A is probably from the second shipment of rails.

Tanner, in a book entitled *Canals and Railroads of the United States*, published in 1841, in describing the Camden and Amboy Railroad, says of the rail used upon it, "The rail was of the H pattern and weighed 41 pounds per yard" and gives its height as $3\frac{1}{2}$ inches.

Section A1, is a tracing of this rail, which can also be found at the Pennsylvania Railroad office, Philadelphia, Pa. Tracing of these two badly worn and rusted sections were secured through the courtesy of Mr. G. W. Whiteman of the Pennsylvania Railroad Company.

These two and several other sections at the Pennsylvania Railroad Company's office and one or two sections at the National Museum, all equally as badly worn, are all that we were able to find of the first tee rails. The rail did not stay at this weight as by 1835 we find rails of this pattern in use on that road weighing 50 lbs. per yard.

The first shipment arrived at Philadelphia on the ship *Charlemagne*, May 16, 1831. The following is an extract from Mr. Steven's letter to the English Iron Master:

"Gentlemen — At what rate will you contract to deliver at Liverpool say, from 500 to 600 tons of railway of the best quality iron rolled to the above pattern in 12 or 16 ft. lengths, to lap as shown in the drawing, with one hole at each end and the projections on the lower flange at every two feet, cash on delivery?"

Mr. Stevens met with considerable trouble in finding any one who would undertake to roll them and did not succeed until he put up a money forfeit which should cover any damage to the mill while rolling them. The limit of this brief sketch will not permit of taking up that side of the question.

Between the years 1831 and 1835 the inverted "U" rail, now better known as the bridge rail, came out, the name bridge rail coming from the fact that this rail was generally laid upon longitudinal sill resting upon sleepers, which gave to the track somewhat the appearance of an extended bridge.

This section A is a copy of a rail drawing sent to the Franklin Institute by Mr. J. C. Trautwine in the year 1835, and marked in use on the Wilmington and Susquehanna Railroad. This is of interest as it fixes the early date at which they came out.

We are not positive where this U rail was first made, but think from what we have learned of it, it was at the Dowlais Iron Works, Wales.

Fig. 23 is another of the early U rails. There were a great many patterns of this rail in use and a considerable mileage of our early railroads were laid with them.

In the year 1837, the Lock rail came out, at first known as the double tee, but now known as the double headed rails. This rail, unlike the Stevens rail, did not come into existence at one bound, but is a development of the Birkenshaw rail, it was found in the Birkenshaw rail that the narrow base where they rest-

ed in the chairs quickly destroyed both the rail and chair at these points. The lock rail was devised to overcome the difficulty by increasing the width of the lower head.

It was thought at first that the increased width of the lower head would not only remedy the fault, but would permit of reversing the rail when the working head wore out, but it was soon found that this could not be done as the rail still wore badly at the points where they rested upon the cast iron chairs.

This resulted in what is known as the bull head rail, No. 2, with the lower head the smallest, which permitted of using more metal in the top on working head for wear. These two rails are still very popular with English Railroad men and are largely used at this time.

We have now shown all of the different types of rails that were used upon steam railroads, all of which were in use prior to the year 1844, when we began to roll heavy rails in America. All of them excepting the Stevens and Lock rails have since gone out of use.

On page 170 is shown a few of the many changes given to the form of the Birkenshaw rail while developing into the British standard of 1905 Bull Head Rail.

At the beginning of the year 1844, there was 4,185 miles of railroad in America. All the rails used upon them except strap rails and a few cast iron rails, were imported from England. The manufacture of heavy wrought iron rails in this country was commenced in that year at the Mount Savage Rolling Mill, Alleghany County, Maryland. There, at some time between April and November, was rolled the first edge rails ever made in America.

The rail is of the U or bridge type, known in Wales as the Evans pattern of the Dowlais Iron Works and weighed 40 pounds per yard. This rail was awarded a silver medal by the Franklin Institute at St. Louis, in November 1844.

The following is a copy of the proceedings of the Institute Exhibit No. 2705:

"A bar of railroad iron of the U form, rolled by the Mount Savage Iron Works near Frostburg, Md., and forwarded by Col. Young, manager. This bar is 18½ ft. long and weighs 40 pounds per lineal yard. It is part of a lot of several hundred recently rolled there for a branch of the Baltimore and Ohio Railroad leading to the works.

This bar is among the first early rails yet rolled in the United States and it demonstrates beyond the reach of cavil that edge rails can be well manufactured in America. This bar is well proportioned, sound and well finished. It is the first ever exhibited here of an American make and we hail it with pleasure as the beginning for a new manufacturer and award it a silver medal."

John Weigand,
Chairman of Committee.

Fig. 27 above is from a piece of the rail badly worn and rusted. This piece, which we have and one other piece equally as badly worn and rusted, are all we could find of the first rail rolled in America, as we believe the rail to be.

We cannot help but wonder what Mr. Weigand would say if he were living today and saw the wonderful manufacturers, as he called them, that have grown up from that first rail.

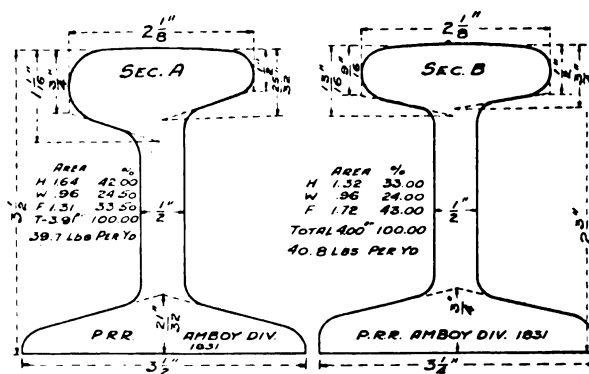


Fig. 21

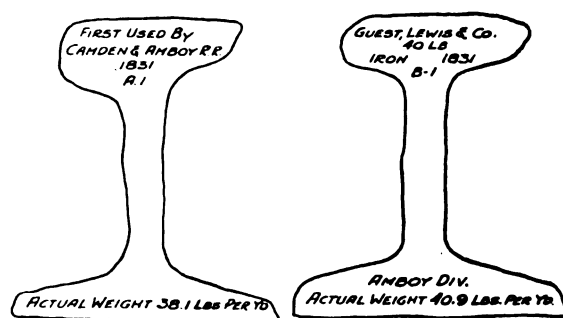


Fig. 22

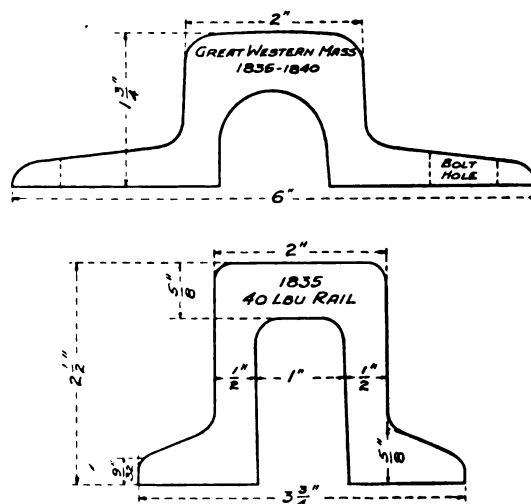


Fig. 23

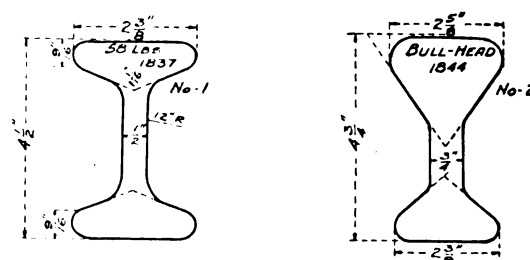


Fig. 24

FIG. 21—Probably the first Tee rails rolled, full size.

FIG. 22—Remnants from these first Tee rails.

FIG. 23—The inverted U, or bridge rail; two variations.

FIG. 24—The Lock-rail of 1837

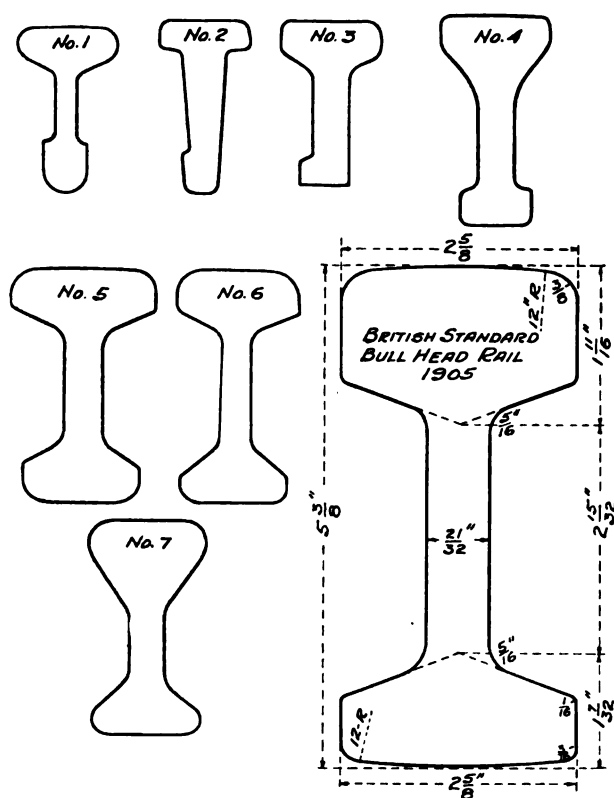


Fig. 25

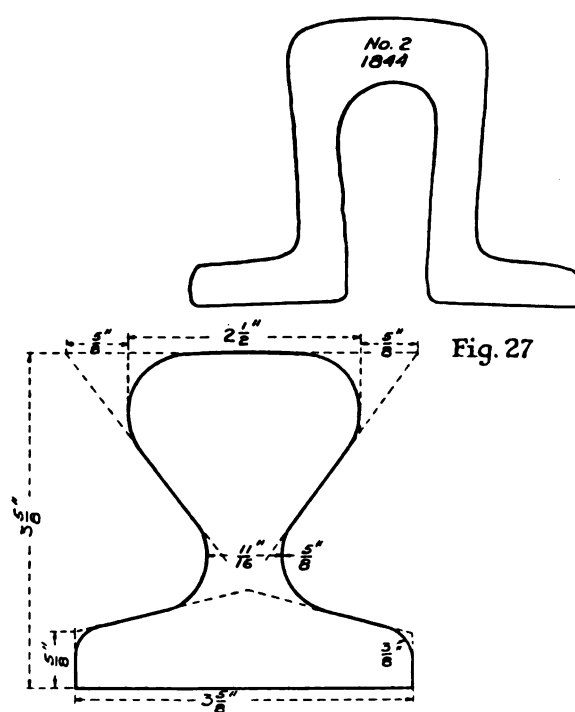


Fig. 27

Fig. 28

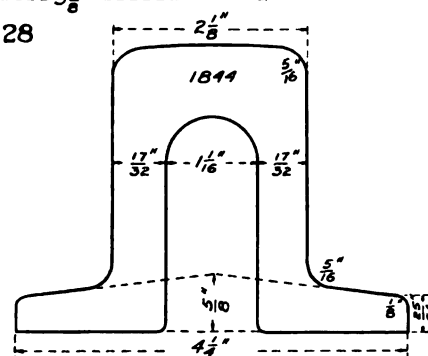


Fig. 26

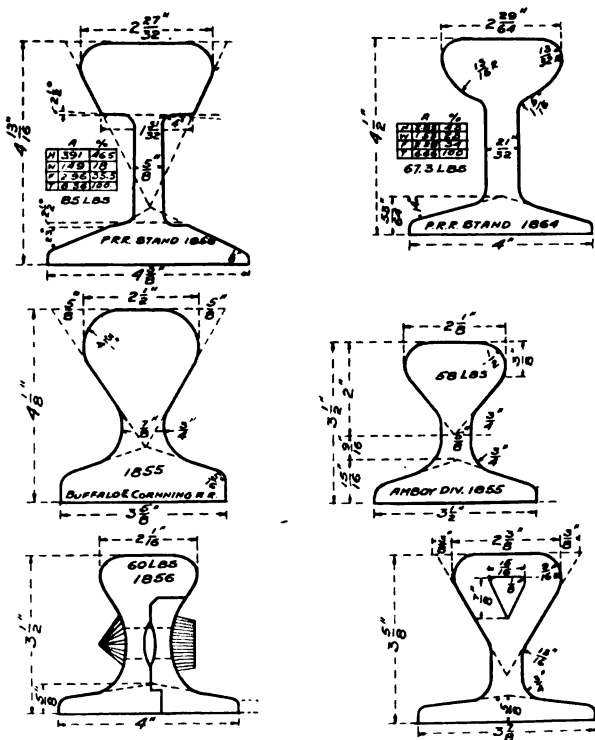


Fig. 29

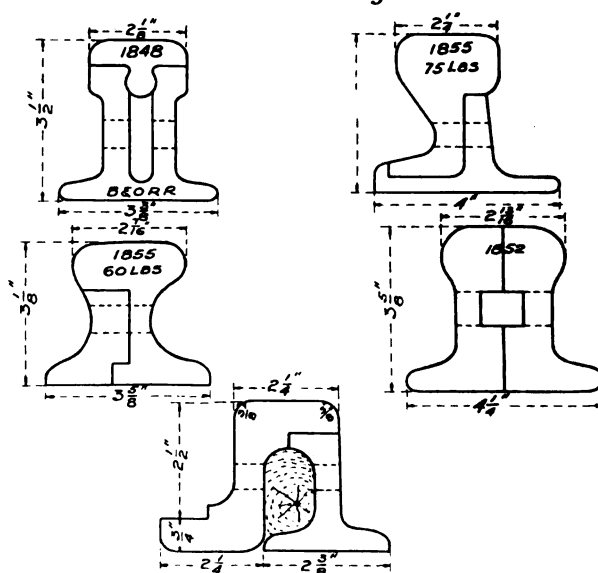


Fig. 30

FIG. 25—Shows the changes made upon the Birkenhead rail up to 1905. FIG. 26—Bridge type, medal winner in 1844. FIG. 27—A remnant of this rail. FIG. 28—The pear-head type. FIG. 29—Forms developed during first 20 years of American rolling. FIG. 30—Examples of compound rails.

Shortly after these 40 lb. rails were rolled a rail weighing 52 pounds per yard was rolled at the Mount Savage Mill for the Boston and Fall River Railroad. This rail has been given credit as being the first rail rolled, by some writers.

The first tee rails made in America were rolled at the Montour Rolling Mill, Danville, Pennsylvania, in the month of October, 1845. This mill was built especially for rolling rails. The first rail rolled was a pattern of the Stevens rail known as the pear head type, Fig. 28.

We are not positive that the rail shown is a correct cross section of the first rail rolled, as all record of it has been lost or forgotten, but we have learned from the men who helped to roll them, that it was a pear head rail with the ends of the flange $\frac{5}{8}$ of an inch thick, and a very heavy web.

The rail we have shown corresponds more closely to their description than any other of the old pear head rails we have found, for that reason we have shown it here as a type of the first tee rail rolled in America.

Rails of this type were very popular during the first 20 years of American rail making. In that time there were a great many different patterns of them rolled and laid down upon our railroads.

The principal cause for this was the designing of the rail sections was largely left to the rolling mill men who would naturally only design such sections as were easily rolled.

We do not find that our Railway Engineers were taking a great interest in the improving of the rail section previous to the year 1865, just 20 years after the first tee rails were rolled.

The sections Fig. 29 show several of the various shapes the tee rail took on in the first 20 years, immediately following the beginning of rail manufacturing in the country.

This same period from 1844 to 1864, was very prolific in the production of compound rails. There rails were laid in the track with the two parts so as to break joints. When new they made a splendid track but it was found that the two parts of the rail could not be kept together, the bolts and rivets wearing out very rapidly and permitting the rails to become loose in the track. See Fig. 30.

A considerable mileage of them was laid but as they could not be made to stand the test of work they have long since gone out of use, for this reason we have not given them much attention. Not so with the inventors who evidently have not given up all hope of making one that will stand the test of use in the track, as up to the present time there are many useless patents being granted for rails of this type. Less than one month ago one of them was brought to me for my opinion of it. After looking at it I told the inventor to go home and forget it.

The period of the greatest importance in the history of the rail was between the years 1847 and 1857, as during that time the Bessemer process of making steel was perfected.

It is a remarkable fact that this, the second great epoch in the history of the railway rail, like the first, should be largely the result of accident rather than of

design, as neither of the two men who were most prominent in the development of this process began to experiment with the thought or expectations of making steel.

Mr. William Kelly, a resident of Pittsburgh, Pennsylvania, began his experiments at Eddyville, Kentucky, in the year 1847, with the idea in view of refining and decarburizing melted cast iron by the use of an air blast by that means save the fuel used in the refining fires in refining the iron used at his forge fires.

Mr. Henry Bessemer began experimenting in 1854 after holding a conversation with Napoleon III, who had lately become Emperor of France. Napoleon in the conversation complained to Mr. Bessemer of the poor quality of the metal used in making cannons and at his suggestion Mr. Bessemer at once began experimenting in London on making a better quality of iron. In 1855 Mr. Bessemer says, "The idea struck me of making malleable iron by introducing air into the fluid metal."

We see from the above that neither one of them began with the thought of making steel. Mr. Kelly with the expectation of developing a process of refining iron without the use of fuel; Mr. Bessemer with the end in view of making a better grade of iron guns; but the ways of providence are beyond the ken of human mind. That those experiments, which practically began on the part of Mr. Bessemer (whose name the process now bears) in the interest of, was, should result in the one invention of the age, that of making cheap steel, which is probably doing more to promote the peace and happiness of man than any other one invention in the history of the world. "There is a destiny that shapes our ends rough hew them how we may."

Mr. Kelly and Mr. Bessemer both failed to obtain any successful results in the manufacture of steel up to the beginning of the year 1857, when the third man, Mr. Robert F. Mushet, of England, supplied the missing link in the chain, by the invention of a process for recarburizing the melted decarburized and desilicized iron as produced by the Bessemer process at that time. This perfected the Bessemer process and from that time we can say the production of cheap steel became a commercial product.

Early in 1857 Mr. Mushet completed his process and made the first Bessemer steel rail.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, ETC., OF

The Blast Furnace Steel Plant

[Required by the Act of Congress of August 24, 1912]

Name of Publication: **The Blast Furnace and Steel Plant**, published monthly at Pittsburgh, Pa. [Report of April, 1925.]

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Editor—F. J. Crolius, 108 Smithfield St., Pittsburgh, Pa.

Managing Editor—L. L. Carson, 108 Smithfield St., Pittsburgh, Pa.

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R. H. Thiess, 426 Byrne Bldg., Los Angeles, Calif.

Known bondholders, mortgagees, and other security holders holding 1 per cent or more of total amount of bonds, mortgages, or other securities:

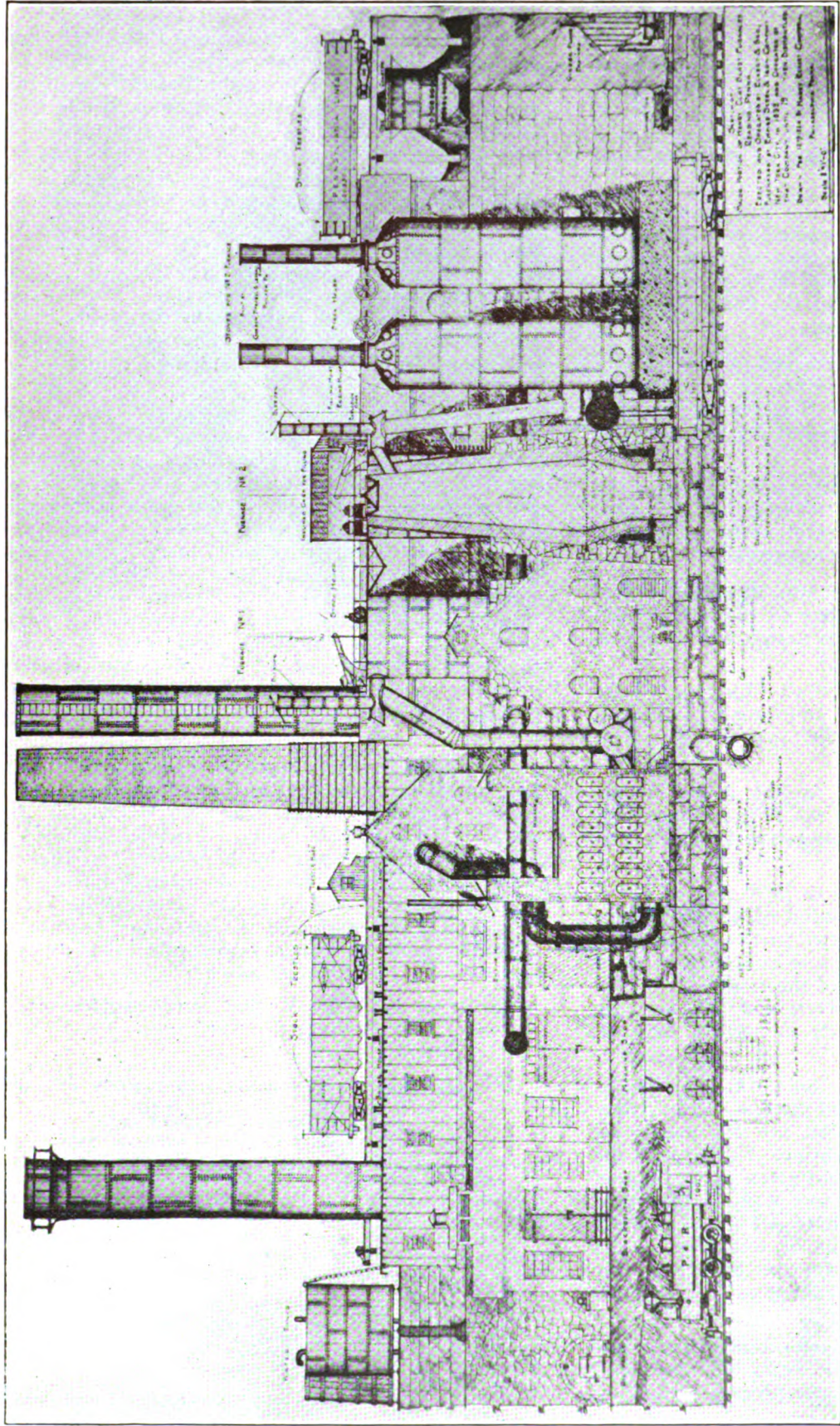
None.

L. L. CARSON, Business Manager.

Sworn to and subscribed before me this 20th day of March, 1925.

CHAS. A. SEIBERT, Notary Public.

(My commission expires March 6, 1927.)



SKETCH FROM MEMORY OF AN HISTORIC FURNACE

A sketch of the major portion of Henry Clay Furnaces, Reading, Pa. Erected and operated by Eckert & Brother. Purchased by the Empire Steel & Iron Company, New York City, in 1899; operated by that company until it was dismantled. Drawn February 12, 1924, by Harry Eckert Cambell, Philadelphia, Pa. Scale $\frac{1}{8}'' = 1' - 0''$.

This sketch was made as a tribute to his father, Colonel David Cambell, who successfully managed these blast furnaces from 1879 until his death, April 2, 1900, and was drawn entirely from the memory of the maker. The furnaces were erected in 1840, the year Henry Clay ran for

election to the presidency of the United States, thereby obtaining their name, the proprietors having been hardened Quakers, and were operated continuously, only being out of blast for relining or repairs until the time of their being dismantled.

The product was open grain foundry pig iron used principally by stove foundries and radiator plants, and was made almost entirely from hot molten furnace sinkers. A small percentage of raw local ore was charged; on account of its high sulphur content, roasting was resorted to.

The Iron Industry of Sweden

A Country Limited in Fuel, But Rich in Water Powers, Has
Pioneered the Electric Furnace

By A. BOGENHOLM SLOANE, B.A.M.A.*

IN proportion to its area, Sweden is no doubt richer in iron ore than any other country in the world. According to a publication compiled by experts from different countries, entitled "The Iron Resources of the World" which was issued at the Eleventh International Geological Congress at Stockholm, in 1910, the iron ore deposits, based on actual investigations, was estimated at about 1,158,000,000 tons, containing about 740,000,000 tons of iron metal. Researches made since 1910 have proved Sweden's resources to be much greater. Sweden has at its command 7.26 per cent of the world's supply of metallic iron contained in iron ore.

For this reason Sweden takes a place in the front ranks of iron producing countries. Its present annual output may be estimated at approximately 7,000,000 tons of iron ore. If the Swedish iron industry were to consume the whole of this quantity of particularly rich ore its production of iron and steel would be very important. Sweden, however, is nearly without coal

deposits. The small amount of coal that is obtained is not suitable for coking. Consequently the Swedish iron industry has been nearly exclusively based on charcoal as fuel and as reducing agent in the blast furnaces. As the supply of charcoal is limited, the quantitative development of the Swedish iron industry has not been able to keep pace with the mining industry, or to progress like that in other countries provided with an abundance of mineral coal. The development of Swedish mining therefore has resulted in a large annual yield of iron ore, corresponding to its great resources. The ore, very low in phosphorus, is utilized at home, as it is best adapted for the manufacturing facilities available with regard to Sweden's resources of charcoal, whereas considerable quantities of ores higher in phosphorus is annually exported to England, Germany and the United States.

The table below gives a summary over the iron in Sweden for the year 1923.

In addition to this there are some plants in which iron manufacture is carried on conjointly with other metal manufacture. The total figures include the

*U. S. Industrial Representative to Sweden; Washington, D. C.

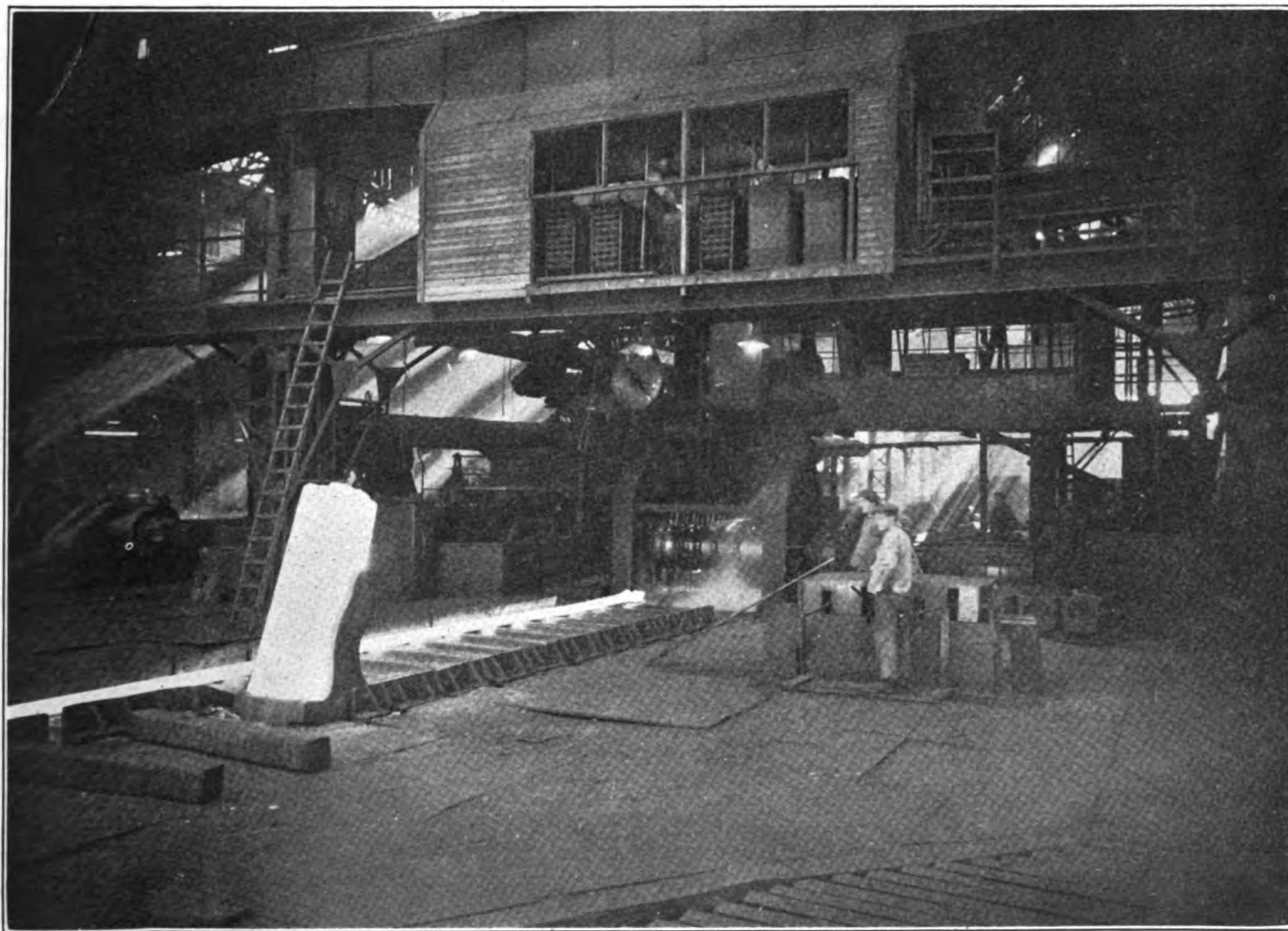


FIG. 1—An excellent view of an ingot entering the mill at the Domneret Ironworks.

Industrial Groups	Personne		Power, in Horsepower		Value of Production 1,000,000; Kronor	Plant Nos.
	Officials	Laborers	Direct Power	Electric Generator Power		
Iron ore mining.....	381	7,772	72,831	8,915	54	95
Iron and Steel Producing Plants.....	1,259	18,707	164,761	132,967	98	95
Iron and Steel Manufacture.....	1,142	13,261	37,952	13,807	94	343
Mechanical Works.....	6,016	34,438	95,659	18,702	272	826
Shipyards and Docks.....	1,137	7,810	25,955	1,080	50	89
Electric Machine Shops.....	1,085	2,819	15,597	540	27	20
Manufacture of Electrical Apparatus, etc....	618	3,103	6,397	540	34	30
Other Iron Industry.....	39	298	334	...	8	21
Mining and Metal Industry, total.....	12,805	96,649	445,628	183,800	728	1,808

whole metal and mining industry of Sweden. The above table has been taken from *Kommersiella Meddelanden*, published by the Swedish Department of Commerce.

Swedish mining methods are up to date, and the equipment at the fields for boring, as well as for transport above and underground, hoisting and concentration of ore, etc., is as a rule of first class quality, and manufactured in Sweden.

The Swedish ores are generally rich but the mines also yield ores that are too poor to be smelted directly and must first be concentrated. In the sphere of ore-dressing and agglomeration, Sweden has in many respects been a pioneer country. It only needs to be mentioned that the Swedish Engineer Grondal has invented several magnetic separators and an agglomeration process without any binding agents. The Grondal method has been widely adopted in Sweden, as well as abroad, for instance, in Japan and the United States.

The quantity and value of the Swedish iron production in 1921 compared to the figures for 1913 are shown by the following figures:

	1921	1913
Iron ore — tons.....	6,464,347	7,475,571
Pig iron — tons.....	314,378	730,257
Bar iron and steel — tons.....	65,969	203,101
Bar iron and steel in 1,000 kronor	22,759	34,417
Other half manufactures of iron and steel — tons.....	120,056	388,592
Other half manufactures of iron and steel in 1,000 kronor.....	48,254	62,512
Drawn and cold rolled iron and steel — tons.....	24,348	40,680
Drawn and cold rolled iron and steel in 1,000 kronor.....	26,240	16,233
Pig iron castings — tons.....	68,610	145,787
Pig iron castings in 1,000 kronor	45,049	34,241
Iron manufactures of various kinds in 1,000 kronor.....	418,624	197,993

With practically only one exception the Swedish iron ore works do not produce cheap iron on a large scale, but manufacture as a rule extra high grade iron and steel with charcoal and ores free from phosphorus and sulphur as raw materials, with workmen engaged for generations in the same trade and supervised by scientifically trained engineers.

During the last decennary electric energy derived at low cost from the Swedish waterfalls has been utilized more and more in the iron production. Also in this domain the Swedish engineers have done pioneer work. Among other things they have constructed an electric furnace for the production of pig iron now used in several works in Sweden and also abroad, for instance, in Italy and South America.

The iron ore mining and the iron and steel industry of Sweden is practically concentrated in the hands of

two large companies, the *Stora Kopparbergs Bergslags Aktiebolag* (The Big Copper-Mountain Company) generally called *Bergslaget* for short, which was organized in the year 1228 and is credited with being the oldest industrial company in the world, and the *Grangesberg Company*, organized in the eighties of the past century.

The *Bergslaget* was first organized for mining copper at the Great Copper Mine at Falun. As large quantities of timber were needed for the mining methods of that time, the company during the early centuries of its existence acquired large interests in the forests of Central Sweden. Later, the company de-

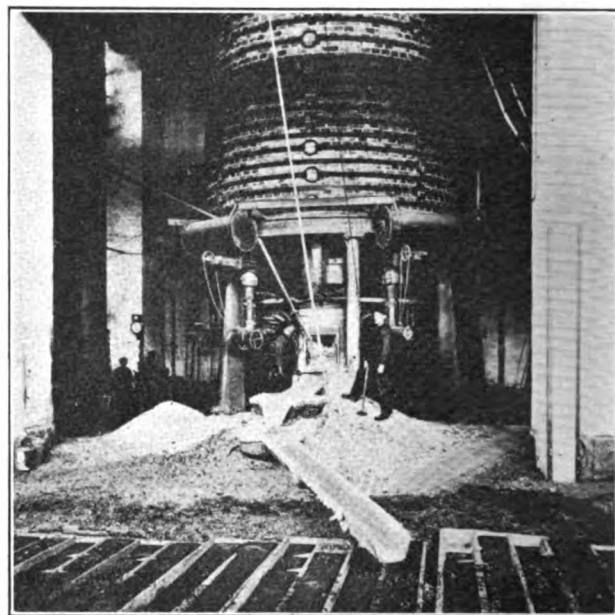
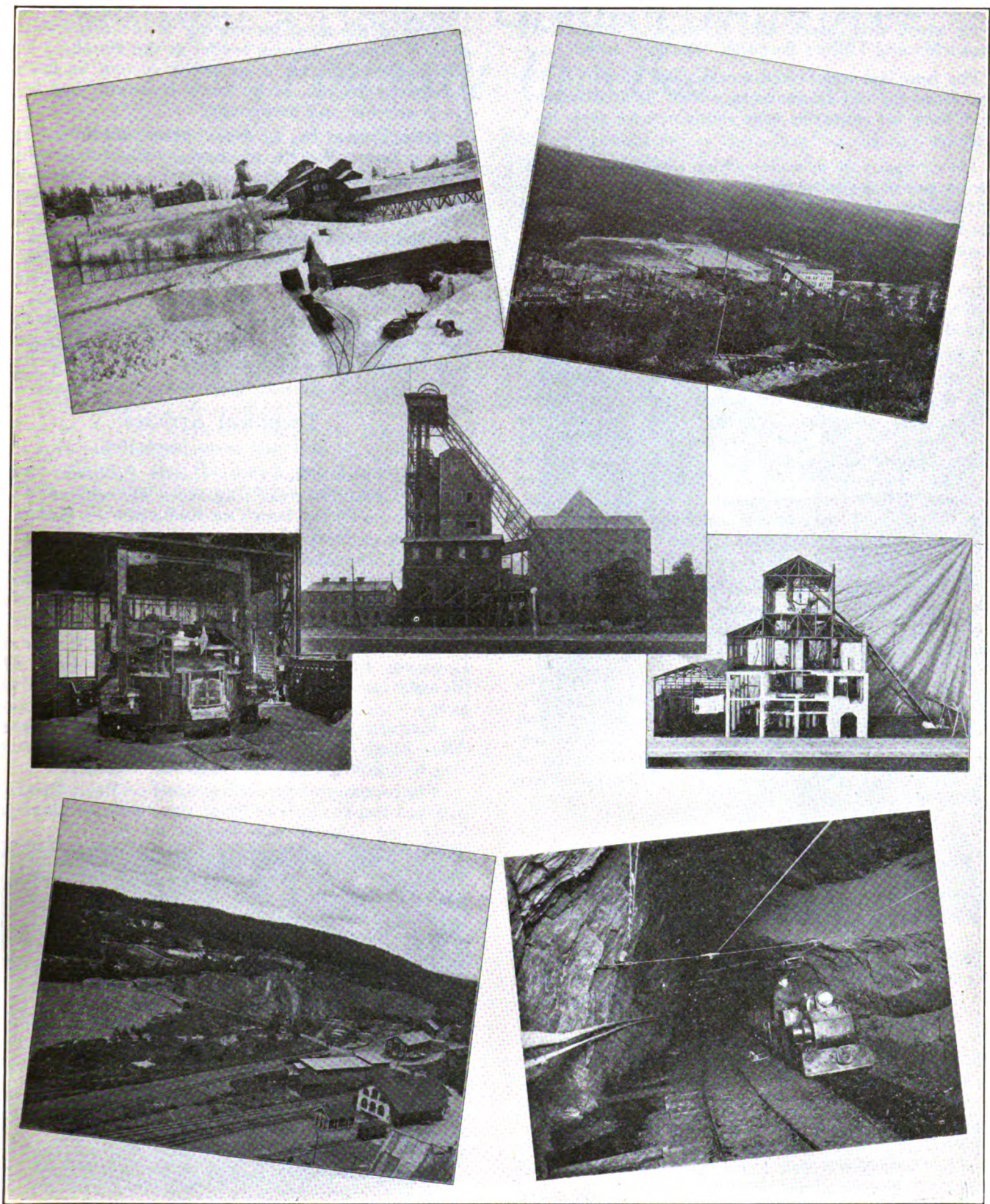


FIG. 2—A modern charcoal kiln at Soderfors.

veloped these interests and is now one of the leading exporters of wood-goods and pulp in Sweden.

In the course of time the company decided to cover its own requirements of iron and steel from its own works. In 1735 the company built its first iron works at Svartnas, in the province of Dalecarlia. At the same time it acquired shares in the *Vintjern* iron ore mines nearby. At present time the company owns wholly or partly most of the iron ore mines and iron works located in Central Sweden. Its iron and steel manufactures, however, have been centralized in the following works: *Domnarvet*, the largest iron works in Scandinavia, *Korsa*, *Soderfors Gysinge*, *Alvkarleo* and *Ullfors*.

These works are producing different specialties. *Domnarvet* carries on the manufacture of ordinary iron



Upper left—Cobbing plant and shaft head at the Captain Mine, Malmberget. Upper right—Concentrating plant at Vitafors. Left center—Electric smelter at the Domnarvet Ironworks; capacity twenty tons. Right center—Model of electric reduction furnace at Domnarvet. Center—Mullers shaft-head with cobbing and concentrating plant. Lower left—Grangesberg; view towards west from Muller's shaft-head. Lower right—Ore train of electric subway of the Grangesberg ore field.

and steel. Korsa manufactures Swedish Lancashire iron, Soderfors high grade steel, notably tool steel, spring steel, drill steel, etc., Gysinge, electro steel, Alvarkeo and Ullfors Swedish "Wallon" iron.

The four last mentioned works take their raw material from the old Dannemora mines, located nearby, which have for centuries been renowned for their high grade ore.

The company owns mines which produce all the different types of ore to be found in Central Sweden, from the non-phosphoric Dannemora product to the high-phosphoric ores of the Grangesberg fields. The iron ore resources are so extensive that they do not only cover the Company's requirements for an indefinite period, but they permit of large ore exports. The higher grades of ores, however, are not exported but utilized entirely in the company's own works.

The ores from the Dannemora Mines contain 50-58 per cent iron, about 4 per cent manganese and 0.002-0.003 phosphorus. The low per cent phosphorus ores which the company has for sale include concentrates and briquettes from the Langgruvan Mine, in the Andersbenning ore field, lump ore and concentrates from the Stripa Mines, besides those from Vintjern ore fields. The company is also interested in the Bispberg Mines, the Johannisberg and Grondal Mines, and in the Klacksberg Ore Fields. These mines all produced ore with low phosphorus content.

But the company has great resources also of ores with higher phosphorus content, among which the Grangesberg ore fields, the Blotberget mines, and the Fredmundberget are the most important.

The Grangesberg ores are partly high phosphoric, with about 60 per cent iron and 1 per cent phosphorus, partly of medium quality with about 58 per cent iron and 0.2-0.3 per cent phosphorus, and also of a quality comparatively low in phosphorus with 50-60 per cent iron, and 0.08 per cent phosphorus. All these ores are very low in sulphur.

Forty-three Awards to G. E. Employees

Forty-three General Electric Company employees have received Charles A. Coffin Foundation awards for having made most signal contributions toward the increase of the company's efficiency or progress in the electrical art during 1924. Twelve of the prizes were won by shop men, five by foremen, fifteen by engineers, and seven by commercial men. Four special awards were made for the presentation of papers at company meetings. With each certificate of award there is a prize of \$250.

Schenectady employees received 16 awards, Lynn eight, the Edison and National lamp works four each, and Pittsfield three. Philadelphia, Buffalo, Erie, Minneapolis, New York, Salt Lake City, Chicago and San Francisco office employees received one each.

The purpose of the employees' awards, established by the board of directors of the General Electric Company in 1922 as an expression of the appreciation of the company for the work in the electrical industry of its founder, Charles A. Coffin, is recognition for unusual service rendered by employees in their work. All employees have equal chances — the work of the shop man is not compared with that of the engineer, but

with that of other shop men. One class does not have preference over another.

One of the most interesting of the cases was that of R. S. Nassif, an oven tender at the Pittsfield works. His suggestion, that a conveyor system be installed, eliminated his job, as he knew it would; but he was given another and better one.

John Flaws, Jr., an experimental machinist at the Edison Lamp Works, received a prize for developing a machine for producing radiotron tube filaments of greater accuracy and more efficiency. It is interesting to note that he also received an award last year, following his development of a more accurate and more economical machine for winding the grids of vacuum tubes.

H. T. Plumb, an engineer of the Salt Lake City office, was very active in rescue work during the Castle Gate mine disaster in Utah. His humanitarian service won for him one of the awards.

Technical Articles

(Continued from page 163.)

Blast Furnace and Open-Hearth Problems — Mining and Metallurgical Engineers at Annual Winter Meeting — Direct Iron Ore Reduction — Manganese Question — New Aluminum Alloys.

Crank Pin Machining Time Cut in Half — Webs and Pins of Oil Engine Shafts Faced and Turned on Special Machine — Noteworthy Accuracy — Novel Features in Its Design.

Properties and Uses of Alloy Steels — Compilation Covering Effects in Heat-Treated Condition, Their Manufacture and Relative Advantages and Disadvantages.

Magnetic and Physical Hardness — Variations in Alloy Steels Caused by Different Quenching Media — Possible Solution of an Unsolved Problem.

Fireproofing of Structural Steel — Basic Principles in Heat Expansion and Heat Conductivity Govern — Suggested Construction Details for Security.

Hardness Numbers and Their Relation — Stress-Strain Curve in Practice and Its Interpretation in the Light of Hardness — A Common Language Suggested.

Electric Washer Production Methods — Drilling Machine Builder, in Taking Up Side Line, Applies Experience in Automobile Production — Single-Purpose Machines Used.

Oxygen Purity and Cutting Efficiency — Research on the Economies Possible from the Use of High-Purity Gas in Oxy-acetylene Cutting of Steel.

Tool Builders and Users Compare Notes — Recent Progress in Design Outlined by Manufacturers at Chicago Machine-Tool Meeting — Users Call Attention to Needed Improvements. — Iron Age during February and March.

Mr. George J. Hagan, founder, and formerly president of the George J. Hagan Company, has disposed of his entire interests in that company, and has opened offices in the Peoples Bank Building, Pittsburgh, Pa. He will devote his entire attention to the design and construction of industrial furnaces, which has been his specialty for the past 28 years.

Cutting Process Greatly Improves Foundry Practice

VISITORS to steel foundries are invariably much interested in the cutting of heavy risers. The whole procedure, from the time the casting is shaken out until the riser rolls off the sand, will impress anyone who is a stranger to the business. The ease with which the average foundry equipment handles material is surprising; but the cutting of risers by the oxyacetylene blowpipe is by far the most spectacular.

It is a common occurrence for the outsider to put the question, "How did you do that before you had cutting blowpipes"? This is a natural question. Not many years ago there were no cutting blowpipes. Frequently, the reply to the question dwells on the difficulties of the old methods; the hours taken to do what now requires minutes, the risk of spoiling expensive castings, and the much greater amount of grinding and other machine work required to finish the job.

As a matter of fact, the advantage of oxy-acetylene cutting does not rest entirely with the ease and economy with which gates and risers can be removed. It has enabled the progressive foundrymen to be entirely independent of former limitations as to size and location of these risers.

It is generally well known that certain places on each particular casting or design should be fed by a generous pool of molten metal. This ideal was all too often compromised, simply because it was next to impossible to remove the risers from the inaccessible places where they were needed most. This is now all changed. The cutting blowpipe reaches any portion of the casting with equal facility. Knowing this,



FIG. 1—Shows the effective use of the cutting torch upon heavy steam turbine cylinders.

it has been possible to redesign entirely the gating of troublesome castings, along logical lines, with the result that defectives are now few and far between. Thus many plants in this country are today making castings of sizes and types which it would have been impossi-

ble to produce before the advent of the oxy-acetylene cutting blowpipe.

They have not only enlarged their range of production; but have increased efficiency and reduced production cost of even their former run of work. A case in point is furnished by the plant which produced the work illustrated in Fig. 1.



FIG. 2—A remarkable new invention which will revolutionize under-sea salvage. This is an under-water hydro-oxygen torch which cuts through an inch and a half of solid steel, even at depths of approximately one hundred feet.

Most of the heavy cutting done at this foundry consists in removing risers ranging in size from 8 or 10 inches up to 20 inches. The steam turbine cylinder casting illustrated, is an example. In this work the risers vary in thickness from 12 to 20 inches. One man with a blowpipe working alone on such a casting could probably have cut these risers within a reasonable time; but the management realized that such work was not a one-man job. They had studied the problem and concluded that additional money spent on labor and equipment would be returned in the final finishing. A machine cutting blowpipe with a straight line machine as accessory is now employed, operated by three men; a cutter and two helpers. One helper maintains proper gas supplies and pressures and the other assists in holding the cut to the proper line. Cuts made in this way are very smooth, close to the

line, and require a minimum of time for final finishing.

A more fundamental development at this plant is in the design of their large molds. Huge Marine gears, weighing 40,000 pounds rough cast furnish an excellent example.

The risers do not take the customary shape, of stems with projecting heads, but form an almost continuous ring about the top of the casting. The six segments are separated only by a narrow space. Good quality steel for the face of the gear, where clear, clean steel is most needed, is supplied at every point by a generous pool of hot metal just above. The improvement in the quality of the work is natural. But this method of pouring could be adopted only because of full confidence in the ability of the oxy-acetylene process to cut the risers smoothly and economically.

Such results clearly illustrate that foundries can increase the scope of their production by thorough study of the possibilities of the oxy-acetylene process and at the same time better the quality of their steel castings while operating at a lower net cost.

Iron and Steel Exports Fall Off During 1924

Despite the fact that exports of iron and steel products from the United States attained figures of 129,465 long tons during December last, thus gaining 4 per cent over the figures for the previous month, total shipments for 1924 fell below the 2,000,000-ton mark for the first time in a number of years, according to the Iron and Steel Division of the Department of Commerce.

Exports for the year in question amounted to 1,805,153 tons and were 10 per cent below those for both 1922 and 1923. Imports totaled 69,281 during December, or more than double the receipts for the month of November.

Considerably more than one-fourth of the 1924 exports were of various kinds of sheets and plates; 14 per cent of the exports were rails and accessories, 13 per cent were tubes, pipes, and fittings, 12 per cent were semi-finished iron and steel; and 10 per cent were structural iron and steel.

Despite the general decrease in the exportation for 1924 as compared with the preceding year, certain products showed gains. The more important advances were made by scrap (31,769 tons), pig iron (9,165 tons), black steel sheets (9,637 tons), tinplate (37,527 tons), boiler tubes and welded pipe (15,523 tons), and barbed wire (15,602 tons). Smaller gains were made in alloy steel bars, metal lath, cast iron pipe and fittings, malleable screwed pipe fittings, car wheels and axles, horseshoes, steel castings, and ferrosilicon.

Trade in the remainder of the iron and steel commodities decreased. The heaviest losses were sustained by ingots, blooms, billets, sheet bars and skelp (15,726 tons), iron bars (7,635 tons), steel bars (59,938 tons), wire rods (22,106 tons), iron and steel plates (30,415 tons), structural shapes, plain material (19,654 tons), steel rails (58,580 tons), plain wire (55,178 tons), and wire nails (24,316 tons).

The importation of iron and steel into the United States during 1924 was small in comparison with that for the two preceding years, being equivalent to about

three-fourths of the volume of receipts in 1923. This decline was more than accounted for by retarded imports of pig iron and ferromanganese, manganese metal and alloys. Pig iron receipts dropped 158,711 tons, and ferromanganese, manganese metal and alloys lost 40,648 tons. The scrap takings fell off 95,185 tons, and tinplate shipments sank from 10,033 tons in 1923 to only 1,036 tons in 1924. Miner losses were sustained by bar iron, round wire, nails and screws, and bolts, nuts, rivets, and washers.

Considerable gain was registered in the sales to the United States of certain foreign-made steel products. Imports of ingots, blooms, billets, etc., rose 16,352 tons, those of structural shapes increased 32,572 tons, rail and splice bar receipts advanced 13,646 tons, and wire rope consignments gained 12,699 tons. Deliveries of tubular products, which had been only 4,960 tons in 1923, amounted to 54,473 tons for 1924. The import trade in ferrosilicon, boiler and other plates, sheets, skelp, and saw plates, flat wire and strip steel, wire rods, and castings and forgings also showed improvement.

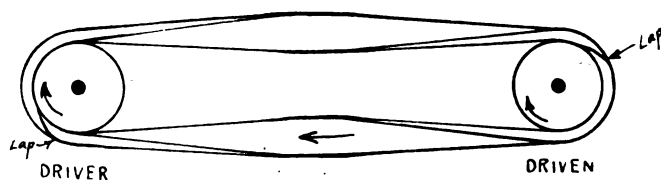
A Belt Lap Kink

By W. F. Schaphorst, M.E.

The old rule regarding the correct way to run the belt laps does not take into consideration the fact that on one pulley the belt slips or creeps in one direction and on the other pulley the slip or creep is in the opposite direction. Slipping and creeping are always toward the tight side of the belt.

Therefore while on the first pulley the slip may be such as to "smooth" the scarfed edge of the joint, any slip on the second pulley would have a tendency to open the joint and cause the feather edge of the lap to roll up.

The sketch herewith shows how, by simply giving one end of the belt a half turn, the tendency will be to "smooth" the joint on both pulleys — which is as it should be.



For wide belts on pulleys that are close together this method is not recommended, but for narrow belts it is all right. Also it will give good results on wide belt drives with pulleys far apart.

Another advantage of a belt turned in this manner is, that each pulley has its own side of the belt to work on — that the flesh side will always be in contact with one of the pulleys and the hair side with the other pulley. Projecting belt fibres therefore are not first bent and rubbed in one direction and then in the other direction, an action that may cause rapid wear. The fibres on both sides of a single belt will lie always in the same direction as the lap — a condition that is ideal. This advantage holds whether the belt is single, double, or triple, and whether leather or fabric.

The POWER PLANT

Highest Pressure Steam Plant

The First 1,200-Pound Generating Unit Goes into Service at Boston

By L. C. BREED*

THE Weymouth steam plant of the Edison Electric Illuminating Company of Boston, will go into service in the near future with its 1,200-lb. boiler and turbine installation, and plans are being made for the development for a transmission trunk line around the suburban district of Boston. It required 28 years from the inception of operations in 1886 for the company to reach 200,000 kilowatts of connected load. The second 200,000 kilowatts were realized in about one-fifth of that time, or in the year 1920. More than half of the third load of this size has now been registered and the belief prevails that with the Weymouth station in operation the connected load probably will have attained a mark of 600,000 kilowatts by 1925, although this surmise may be modified by developments in the general business situation in the intervening period. Statistics also show that the maximum load on the minimum day in 1922 was larger than the maximum load on the maximum day five years previously, in 1917, the year the United States entered the war. In the face of steady gains in power consumption the consumption of coal per kilowatt hour generated has been declining.

The new generating station will rank as one of the largest central electric stations in the United States, which also means in the world. It is an ambitious project as indicated by the fact that the expenditure of approximately \$10,000,000 is planned to take care of the present development, and when the final programme of having ten units in operation has been carried out the company will have expended in the vicinity of \$30,000,000 at Weymouth. The company will defer the building of the two additional units until such time as the management feels that the needs of business and industry warrant the expansion. This first unit reaches 60,000 kilowatts.

Turning to engineering phases of the problem, any steam generating station on our coast must be placed within easy access of the ocean so that barges can carry coal to the property without hindrance from shallow water. Fore River with its deep channel — deep enough to accommodate the large battleships which have been constructed at the Bethlehem Steel Company's shipbuilding plant which lies directly across the strip of water from the Edison location — offered the only desirable site for coal-unloading towers. The channel will be 28 feet in depth so that it should be capable of taking care of the largest boats that can come up from the outer harbor for many years. A

travelling bridge will span the storage pile, and a system of belt conveyors will be provided for transporting the coal to or from the main storage and directly from the unloading towers to the station bunkers. The conveyor for delivering the coal to the station will be about 700 feet in length, including a tunnel under Bridge Street. The travelling bridge is to carry a trolley with bucket for reclaiming from the storage pile, and a breaker will crush the coal on its way to the station.

The coal which will be used at the plant is mined in West Virginia, so that it will be hauled by rail to Norfolk or Newport News and thence shipped direct to the wharf at Weymouth. It is unloaded electrically and is either placed in storage or is distributed into bunkers over the boilers, a forty-eight hours' supply being furnished for each boiler. Gravity is utilized to send the coal down spouts into hoppers and thence into the stokers, where it is automatically pushed into the furnaces. The ashes will drop through clinker grinders into ash hoppers and the accumulation will be removed by trucks or by railroad cars. A remarkable feature of the coaling operations is that the fuel will not be touched by human hands from the time it is mined until the residue of the ashes is disposed of.

Incidentally, while on the subject of generating electricity by the use of coal it is of interest to state that the report made to the Associated Industries of Massachusetts by its Power Investigating Committee in April, 1924, on the power situation in New England, made the point that notwithstanding the potential hydro-electric power to be obtained in Canada and elsewhere, Massachusetts and other New England States must continue to depend in great measure on coal for the additional power which will be needed in future years. While it is to be desired that the black coal should be supplemented with the white, the development of waterpowers will not put an end to the use of coal. It may serve, however, to restrain rising costs of the product of the mines.

The spring will witness one-third of the projected units in operation, the operations will represent only one-fifth of the turbine capacity. That is, the unit now building will contain two turbines as compared with the ultimate plans for 10 turbines. Each unit will have eight smoke stacks projecting 266 ft. into the air above mean low water, which is 45 ft. higher than Bunker Hill Monument. Lightning rods are set on top of the stacks, and "fool-proof" ladders have been attached to the sides of the chimneys. The men will mount the ladders on the inside and it has been demon-

*Boston, Mass.

strated that if one should grow faint or lapse into unconsciousness for any reason one could not drop more than two or three rungs before being caught up.

There is no need of inhabitants of the surrounding territory becoming agitated over a smoke nuisance, as the potential consumption of coal at the plant has been so carefully analyzed from a scientific standpoint, with a view to securing the greatest possible amount of energy at the least possible expenditure, that smoke will rarely be seen emerging from the chimneys.

Many new machines and new economies in building are being installed at Weymouth to secure the maximum efficiency and economy of operation. Probably the outstanding innovations are the installation of a single boiler to carry steam at pressures up to 1,200 pounds and the erection of a switch house separate from the station so that, if by any chance, there was an accident or some other unforeseen contingency at the station it would have no effect upon the employees in the switch house. This latter might be called the heart of the plant as therein are installed the amazing devices for the control of the electric service. The boiler referred to above will have practically the same heating surface as the normal pressure boilers. The steam generated by it will pass through a pressure-reducing turbine developing about 2000 kilowatts, and will be exhausted at a pressure of 375 pounds. After being reheated to the original temperature of 700 deg. the steam will be piped to the main header and used in the large turbines. If satisfactory results are obtained from the high-pressure boiler-turbine units more of them will be put in. Three will be required to furnish steam to operate one of the 32,000 kilowatt units, of which latter two will be installed at present. It is the belief of the engineers that the high pressure system will be very economical, and the opinion has been ventured that power can be produced as economically at Weymouth by steam as it could be by a hydro-electric project on the St. Lawrence River. The station units will be divided so as to reduce to a minimum the danger of destruction.

The high-pressure system might be said to give the station so much "velvet" or free pressure. After the high pressure accomplishes its work in the turbine and gradually loses its force in so doing it is exhausted at a pressure of 375 pounds, which is the normal gauge of the other boilers, and is then reheated and used over again along with the steam generated by the other turbines. The great power of a boiler generating steam at 1,200 pounds per square inch may be gleaned from the fact that it is five times that used in the most powerful locomotive and about three times the pressure ever used before in a large power plant. Certain sections of the boiler have the strength of ordnance. The boiler drum will be 34 ft. long with walls of solid steel four inches thick.

Current will be generated at 14,000 volts, with three-phase, 60 cycles. It will be distributed from the station through underground circuits partly at generator voltage and partly at 25,000 volts through an adjoining outdoor transformer substation. Future transmission by overhead lines at 115,000 volts will also be provided for. The cables will be laid under Fore River.

I. E. Moulthrop, assistant superintendent, bureau of construction of the Edison Company, says regarding the high-pressure installation:

"There are many new problems involved in the design, construction and operation of this high-pressure and reheating installation, but their nature is such that their solution may be confidently expected. It is recognized, however, that a considerable amount of development work will have to be done. It has therefore been decided to employ proven types of equipment for the larger part of the initial installation, confining the use of equipment which is as yet lacking commercial demonstration to a comparatively small supplemental installation of one high-pressure boiler with its turbine unit. This installation will afford an opportunity to demonstrate the general practicability of using very high-pressure steam in a re-heat cycle.

"The ratio of high-pressure equipment and normal pressure equipment to be installed in the future will depend upon the results obtained from this initial installation and upon the experience of others who are working along similar lines, or who are employing other methods for the utilization of high-pressure steam and the re-heat cycle.

"Any estimate of the improvement in heat utilization to be expected from the use of very high steam pressure, is necessarily based on assumed properties of steam obtained by extrapolation of existing steam tables and diagrams, which may be subject to some correction. The calculated savings are so large, however, that it is felt that any probable error in these estimates will not be material.

The importance of this engineering enterprise in the minds of the management is seen from the fact that upward of 500 photographs were taken of the various parts of this great plant.

Stone & Webster, Inc., Boston, were the contractors for the construction of this plant.

New Code for Testing Steam Boilers

In 1886 a committee appointed by the American Society of Mechanical Engineers formulated a code for the testing of steam boilers which soon became the standard practice of the profession and the basis upon which performance guarantees were drawn and settled.

At that time there were no other recognized rules for practice extant in this country. The Institution of Civil Engineers of Great Britain appointed a Committee on Tabulating the results of Steam Engine and Boiler Trials in 1897 and their report, made in 1902, is now under revision by a Joint Committee of the Institutions of Civil and Mechanical Engineers.

In the thirty-eight years that have elapsed since the adoption of the original A.S.M.E. Code it has undergone several revisions made necessary by the progress of the art. Such a revision has just been completed and the code is now available in the thoroughly up-to-date form in which it has been adopted by the Council of the A.S.M.E. as the approved standard practice of the profession.

The committee in charge of this 1923 revision consists of Edwards R. Fish, vice president, Heine Boiler Company, chairman; Arthur D. Pratt, Babcock & Wilcox Company, secretary; Alex D. Bailey, superintendent of generating stations, Commonwealth Edison Company, Chicago; Albert A. Cary, consulting engineer, New York; and Edwin B. Ricketts, assistant to chief operating engineer, New York Edison Company.

The earlier 1915 draft of the code for stationary steam boilers related primarily to tests made with coal, while the latest (1923) revision covers in a complete way tests with (a) solid fuels, (b) liquid fuels, and (c) gaseous fuels. The use of each of these types of fuel is treated when stokers, superheaters, economizers and air preheaters are attached to the boiler.

The text of the code has been completely rewritten and the data and results section has been developed in an entirely new form. It now contains separate tables for each combination of apparatus, each item of which is covered by an item in a corresponding section devoted to computations. As a result of this arrangement considerable time will be saved in computing tests made according to this standard code. To further facilitate the computations and record of stationary steam boiler tests the A.S.M.E. is planning to issue in separate pad form the various data, heat balance, and computation sections.

NEW MILL AND CRANE CONTROL

A development promising to be of much value to the steel industry and other industrial activities where reversing and non-reversing d.c. motors are used is the new mill type, magnetic time controller marketed by the General Electric Company. This control has been especially designed for use with steel mill auxiliaries and cranes and hoists.

Simplicity is the keynote of the new control. Among the advantages claimed for it are ease in repair, well constructed and easily accessible parts, simplicity in wiring and a strong angle iron frame on which the control is mounted. Bases are moisture resisting, being constructed of a strong compound and chosen for their excellence in dielectric strength.

A time limit scheme of acceleration is provided when starting, and current limit for plugging when reversing. Controls are provided with instantaneous electrical reset overload relays.

Twelfth National Foreign Trade Convention

The call and preliminary program of the Twelfth National Foreign Trade Convention to be held at Seattle, Washington, June 24, 25 and 26, which have just been issued by James A. Farrell, Chairman of the National Foreign Trade Council, reveal an advanced state of plans for what is to be the council's first comprehensively international convention.

Delegations of business men have accepted the council's invitation and will come to Seattle from Japan, China, India, Straits Settlements, the Dutch East Indies and the Philippines. They will take an important part in the group sessions on the practical phases of foreign trade, which will cover such vital matters as credits and credit information, selling methods, packing, shipping, documentation and finance, and advertising. As announced by the council's headquarters in New York, group sessions will be held on American foreign trade problems in each one of these Eastern nations, and at each group session at least two of the speakers will be business men from the country under discussion.

The delegations from the Orient were invited by a special mission of the Seattle Chamber of Commerce which returned from a successful six weeks' journey to the Orient on March 17, and reported that the Coun-

cil's invitation has aroused wide interest in the Far East and will result in substantial and representative delegations from each of the countries mentioned.

An additional group session of special interest in view of the improved conditions under the administration of President Calles of Mexico will be devoted to the Republic of Mexico.

Although stressing new American opportunities in Oriental trade, the Twelfth National Foreign Trade Convention will be as heretofore a forum for the discussion of the most general and the most vital interests which all Americans have in the \$8,201,534,524 worth of foreign trade done in 1924. An annual American production of more than \$70,000,000,000 stands behind this foreign trade, finding its own outlet and its exchange for world products a vital necessity of our economic system.

Last year, declares Mr. Farrell in his call to the convention, the volume of American foreign trade exceeded 92,000,000 tons, or more than 252,000 tons for every day in the year. This immense volume of business comprised 49,200,000 tons of American products exported to all the countries of the world; and 42,800,000 tons of foreign materials imported into the United States to serve the needs of our industries and our people.

"This year," declares Mr. Farrell, "gives promise of exceeding 1924. There is a new assurance of stability and progress in Europe, where steady improvement has been made for the last six years. There is increasing activity in the countries across the Pacific, as well as in South America and other overseas markets. American foreign traders have seldom, if ever, faced a more hopeful outlook."

Three special trains, making sleeping car connections with all eastern and central cities, are scheduled to leave Chicago for the convention by the Great Northern, Chicago, Milwaukee & St. Paul, and Northern Pacific Railroads. The cities of the Pacific Northwest, led by the Seattle Chamber of Commerce, have made special arrangements for business and sightseeing tours to present an object lesson to the rest of the country in this area, whose population is growing at five times the rate of the rest of the United States and whose foreign trade, in the Washington customs district alone, has increased from \$175,000,000 to \$426,000,000 in the last four years.

Sheffield's Record Rail Shipment

By A. C. Blackall

A record is claimed to have been established by the despatch by rail of an anvil block weighing 95 tons from a Sheffield (England) iron and steel works. Considerably bigger castings have been made in Sheffield but these have all been for Sheffield concerns, and there is no record of railway transport from Sheffield of such a huge casting as that which was recently sent out.

The big anvil block was produced at the works of the Brightside Foundry and Engineering Company. Four cupolas and two air furnaces were blowing simultaneously to obtain the necessary metal, which was all down in three hours, the cupolas contributing at the rate of 28 tons per hour. The feeding of the casting took approximately 30 hours from a stand ladle of 42 tons capacity, a 23-ton ladle, and two 17-ton ladles. The casting was left in the pit for about 15 days, and was finally lifted out by means of a 120-ton crane.

TRADE NOTES AND PUBLICATIONS

Homestead Valve Expands

The following mill and mine distributors have been appointed as agents for the Homestead line. They will handle Homestead Quarter Turn Valves used in almost every industry, the Hovalco-Homestead Combination Blowoff Valves, the Homestead Protected Seat Globe Valve and Hydraulic Operating valves and all other products of the Homestead Company. They will carry a stock of this material and be prepared to render service to users or prospective users at all times.

W. A. Case Sons, 72 St. Paul Street, Rochester, New York; The Fulton Supply Company, Atlanta, Ga., and Charles A. Setzer, manufacturers agent, 725 Realty Building, Charlotte, N. C.

The U. G. I. Contracting Company, of Philadelphia, has secured contract for and is preparing to install, in conjunction with Wilputte Coke Oven Corporation, two 10-ft. set of Blue Gas Apparatus at the plant of the Perry Iron Works in Erie, Pa. The apparatus will be of the U. G. I. cone top type and the generators will have hopper bottoms. The blue gas will be used for firing the ovens. In addition to the blue gas apparatus, the contract calls for the installation of blowing plant, hydraulic pumping system, exhaust steam system, scrubbing equipment, charging larry and ash cars. With the Blue Gas Apparatus, there will be installed two U. G. I. model "B" automatic controls. In addition to making installation, the U. G. I. Contracting Company will also design all steel and architectural drawings required for the work. The Perry Iron Works is a property of Picands, Mather & Company.

There has just been issued by the Botfield Refractories Company, Swanson and Clymer Streets, Philadelphia, Pa., a very useful pocket-size booklet, of interest to all users of fire brick. It contains a number of helpful fire brick construction suggestions. Among these are, the proper method of laying fire brick for thin but firm joints; how to coat furnace walls and other fire brick construction to protect the brick and prolong its life; the method of filling up holes and depressions with an inexpensive patching mixture, saving many dollars of new construction costs; how to lay up single ring arches, in which any one brick or part of a ring can be replaced without removing other rings.

An informing discussion of apparatus for the production of distilled water for boiler feed make-up is presented in a 32 page catalog distributed by the Wheeler Condenser & Engineering Company, of Carteret, N. J. The fitting of evaporators into power plant heat balance and the relation of the evaporator to other heat balance equipment is discussed, and various types of hookups are illustrated by the heat balance diagrams of representative stations, such as the Delaware Station of the Philadelphia Electric Corporation, the Hales Bar Station of the Tennessee Electric Power Company, and the Seal Beach Station of the

Los Angeles Gas & Electric Corporation. The operating characteristics of four types of evaporators are described, two of which are film evaporators in which evaporation takes place from a falling film of liquid produced by showering the water over the tube nest, and two are submerged tube evaporators. A film type evaporator in which the evaporating surface is composed of return bend tubes is recommended for large multiple effect, low or medium pressure installations, while for smaller installations the Ellipticoil film evaporator in which, to facilitate scale cracking, the tubes are shaped like two joined Bourdon gage tubes, is available. An evaporator with Ellipticoil tubes and similar to the Ellipticoil film type evaporator except that the tubes are submerged, is also used in low and medium pressure installations, where submerged tube operation is desirable. For very high pressure installations, there is the Wheeler Contraflo submerged tube evaporator. Other topics of interest are the advantages of distilled boiler feed water and the relative economy of multiple effect operation as affected by the number of effects and the direction of liquid flow.

The Crocker-Wheeler Company, Ampere, New Jersey, report increased buying activity on the part of steel mills. Among the recent orders placed for Crocker-Wheeler apparatus are the following:

Ordered by the Sharon Steel Hoop Company for plant at Sharon, Pa., to be used for rolling mill drives and auxiliary motors, three 2000 kw, 3-unit motor-generator sets, each consisting of one 720-rpm., 60-cycle, 3-phase, 2300-volt synchronous motor, operating at 80 per cent power factor, and two 1000-kw., 250-volt, compound-wound, d.c. generators.

For plant at Youngstown, O., to be used for sheet mill drives: Three 1000-hp., 300-rpm., 60-cycle, 3-phase, 230-volt, enclosed ventilated, coupled type, slip ring motors.

For plant at Lowelville, O.: One 1000 kw. synchronous motor-generator set.

Ordered by Central Furnace Company (subsidiary of Central Steel Company, Massillon, Ohio: Thirteen d.c. M. 11 type motors, aggregating about 1400 hp.

These motors will be used to operate an ore bridge and a car dumper for a new furnace to be built at Massillon, Ohio.

Hodson Enters Consulting Practice

Mr. Frank Hodson, formerly president of the Electric Furnace Construction Company, Philadelphia, and vice president of the General Furnace Company, announces that he is severing his connection with that company and will probably go into business for himself as a consulting engineer and metallurgist, specializing on making investigations and reports on new patents and inventions and their practical applications in metallurgy and an inspector and appraisal of metallurgical plant for the purpose of combines, insurance, etc.

The Applied Science Department of the School of Technology of Sheffield, from which he graduated, might very well be taken as a model for similar institutions here. The department has made provision for practical training of metallurgist by taking over a small works and installing there commercial sized cupolas, open hearth, gas producers, Bessemer converter, electric furnaces and crucible holes. All the work is done by the students under the direction of skilled practical men who are loaned to the university by various works in the district. The students commence the first year with the laboring work around the plant, charging, sample taking, preparation of ladles, molds, etc., and analysis of material, finally in the fourth year taking charge of the steel making. During the summer vacation, jobs are usually found for many of the students to continue their practical work in one or other of the large steel works in the district. The result is a thorough practical as well as theoretical knowledge of the metallurgy of iron and steel. Mr. Hodson is very enthusiastic about this kind of training and has been trying for years to find someone big spirited enough and with enough capital to help him work out something similar for an American School of Technology. There is a fine opportunity for some individual or concern to establish a worth while foundation that would be of immense benefit to the future metallurgical industry of America.

Mr. Hodson early in 1918 formed the Electric Furnace Construction Company of Philadelphia and installed the first two 3-ton Greaves-Etchells Electric Furnace units at the Halcomb Steel Company, Syracuse. Since that time, more than 30 furnaces of various types and sizes have been installed under his direction at American plants including five large units for the U. S. Navy Department, five for the Ford Motor Company—including the largest electric furnace in the world of 60-tons capacity and 12,000 kva. transformers. Mr. Hodson's company took up the manufacture of electric heat treating furnaces and has done notable work in the United States, Spain and Japan. They designed and installed the first continuous electric annealing furnace and the largest electric gun treating furnace outside the United States—the first continuous electric vitreous enamelling furnace for the Armstrong Manufacturing Company—the first continuous electric hardening and tempering furnace for hand saws for Hy Diston & Sons. Mr. Hodson was responsible for the introduction of the "Kaelin" type electric steam boiler to the United States and in three years over 300,000 kw. of this type of electric boiler have been installed and contracted for. He also was closely connected with the development in the United States and the tests that are now taking place here of the "Soderberg" continuous self baking electrode — that may revolutionize some present methods and industries.

He is a regular contributor on metallurgical and technical problems to technical societies and press. He is a member of the American Institute of Mining Metallurgical Engineers of the Association of Iron and Steel Electrical Engineers of the Electro-Chemical Society of America, American Foundrymen's Association, Iron & Steel Institute (both American and British), Heat Treating Society.

Mr. Hodson served with the committee appointed by the United States Department of the Interior to study the use of oxygen and oxygenated air in the

metallurgical and allied processes. The report serial No. 2502 Bureau of Mines, Washington, contains some of the first work done on the very important metallurgical subject.

He has just returned from a three months' business trip to South America where he reports considerable new activities in mining and metallurgy. He has secured a number of contracts for American built plants, some of them of considerable magnitude. Mr. Hodson is very impressed with the possibility of some of these Southern Countries becoming factors in furnishing the United States with raw materials, iron, ore, coal, cobalt, nickel and many other minerals. He states many large and workable deposits exist and believes it is only a matter of time before they are utilized.

"General Electric Welding Electrodes" is the title of a small 16-page, illustrated booklet just issued by the General Electric Company. This booklet describes the characteristics and applications of the three types of General Electric electrode, designated as Types A, B and C. Brief instructions are given covering the use of each type.

Bulletin No. 145 of the Engineering Experiment Station of the University of Illinois, entitled "Non-Carrier Radio Telephone Transmission," was published as the result of an investigation of the relative merits of a number of radio telephone transmitting systems. At present all of the standard transmitters send out a carrier wave of inaudibly high radio frequency modulated in intensity or amplitude at speech or audio-frequency by the microphone of the transmitting station. This system has certain disadvantages, however, and for this reason the authors of the bulletin have devised a method whereby the radio frequency waves are sent out only while voice or music tones are being transmitted. The carrier wave is thus eliminated in the sense of a wave constantly on the air, although there is a radio frequency wave while modulation is required for transmission. This bulletin describes the fundamental principles of the non-carrier method of transmission, and points out the advantages of this method over those in use at the present time. Copies of Bulletin No. 145 may be obtained without charge by addressing the Engineering Experiment Station, Urbana, Illinois.

Coincident with the establishing of a welding service department to handle welding rod problems for customers, the Page Steel & Wire Company announces the appointment of J. J. Flaherty to direct sales of Armco, High Carbon and Low Carbon welding rod wire. Mr. Flaherty, who was formerly in charge of welding for the Boston Elevated Railways, will have headquarters at Bridgeport, Conn.

Okonite Opens St. Louis Office

In order to best serve the interests of their customers in the middle west, the Okonite Company, Passaic, N. J., manufacturers of insulated wires and cables have opened a sales office in St. Louis at 444 Frisco Building, with Mr. L. R. Mann in charge.

WITH THE EQUIPMENT MANUFACTURERS

Technical Executives to Meet

June Chemical Equipment Exposition in Providence Backed by
Internationally Known Companies

A TECHNICAL-INDUSTRIAL gathering of 1,000 persons, representing single plants and entire industries, the annual productive capacities of which run into billions of dollars, is assured in connection with the Chemical Equipment Exposition to be held in Providence June 22-27, inclusive, 1925.

This announcement is made by the Association of Chemical Equipment Manufacturers, the trade association of large equipment companies which is managing the Exposition.

Wide Technical Support.

The Exposition is endorsed by the Society of Chemical Industry, American Section, the American Association of Textile Chemists and Colorists, the New Jersey Chemical Society, and other technical organizations. It is also announced that in conjunction with the Exposition will be held regular sessions of the American Institute of Chemical Engineers, one of the country's major engineering societies.

"The Exposition is designed solely for the benefit of industrial and technical men in the chemical and chemically-dependent industries. It will serve to introduce to manufacturers in many industries, not customarily thought of as 'chemical,' modern engineering processes and equipment for performing profitable single or multiple chemical phases of production.

Twenty Industrial Groups.

"The chemically-controlled industries are: heavy chemicals, fine chemicals, coal products, dye, fertilizer, explosives, alcohol, electrochemical, electrometallurgy, ferrous-metallurgy, non-ferrous-metallurgy, ceramics, petroleum, paper and pulp, rubber, paint and varnish, leather, lime and cement, soap, oil, sugar, food products, wood products, animal products.

World-Known Companies.

The Chemical Equipment Exposition is supported by such companies as the Buffalo Foundry & Machine Company, the Bethlehem Foundry & Machine Company, General Ceramics Company, United Filters, Raymond Brothers Impact Pulverizer Co., Oliver Continuous Filter Company, Aluminum Company of America, Swenson Evaporator Company, The Dorr Company, Leeds & Northrup, Carbide & Carbon Chemical Corporation, American Hard Rubber Company, Linde Air Products Company, United Lead Company, The Pfaudler Company, The Bristol Company, General Electric Company, Tolhurst Machine Company, U. S. Rubber Company, Duriron Company, Inc., International Nickel Company, etc., etc. Many other nationally and internationally known equipment companies are included.

The Exposition will be held in the State Armory. The general headquarters of the Association are 1328

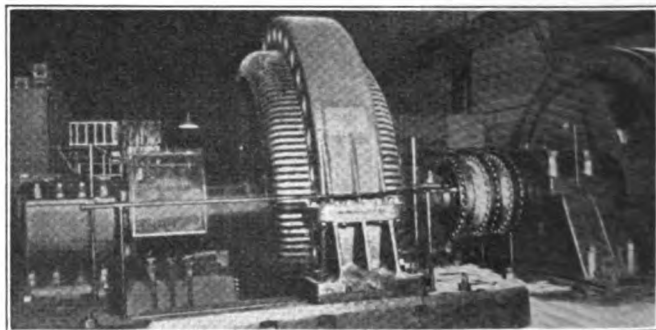
Broadway, New York City. The Providence-Biltmore, Narragansett, Dreyfus and Crown Hotels in Providence are now accepting reservations for the period of the Exposition.

Bartlett Hayward Fast Flexible Coupling

Bartlett Hayward Company of Baltimore, Md., have recently issued a concise four-page bulletin of their Fast Flexible Coupling (self-aligning). The simple underlying principle upon which Mr. Fast's theory is based is explained as follows:

Two generated spur gears, one on each shaft end, are completely and continually meshed with the generated internal gear of a floating sleeve. The shaft and sleeve revolve as one unit, allowing the sleeve free angular and lateral float. That is the simple principle of Fast's flexible coupling.

No rubber, no leather, no fibre, no laminated steel pins, grids or disks—no flexible materials to wear and break down and limit the life of the coupling. Fast's coupling is an all-metal, double engagement lubricated coupling, based on a mechanically correct principle.



Like any other piece of transmission machinery, Fast's coupling is positively lubricated. When the sleeve is partly filled with oil, centrifugal force submerges the gear teeth in an oil-pressure bath, creating a permanent oil film between the teeth. This oil film becomes a load carrying surface on the full face of the teeth. There is no metal-to-metal contact—therefore there is no wear. Offset and angular misalignment are compensated for; free lateral float of the shafts is provided for; all whip and crank action is eliminated. Long life, utmost dependability, real coupling efficiency—these are the things that have made Fast's flexible coupling the choice of the largest and most exacting plants in the country.

A number of typical installations, similar to that shown in the illustration, are reproduced in the bulletin.

Some Pointers on By-Product Coke Oven Operations

Circular on Fuel Gas Analysis

All of the many industries engaged in producing fuel or utilizing it in any way find that gas analysis is an essential accompaniment to their work. In the operation of gas producers, the percentage of carbon monoxide, carbon dioxide, oxygen, hydrogen, and hydrocarbons must be determined. The same determinations must be made for by-product coke oven gas, retort gas, water gas, carburetted water gas, and natural gas. When gas is sold to consumers a very complete check on the composition of the gas is necessary. The analysis must be made rapidly and accurately, for it is used in controlling many industrial operations and determining their efficiency, as well as to indicate to the consumer what he is buying.

Circular No. 12 of the Engineering Experiment Station of the University of Illinois, entitled "The Analysis of Fuel Gas," gives a description of the apparatus developed at the University of Illinois for the purpose of analyzing fuel gas, and contains a synopsis of the methods which are best adapted to this type of apparatus. These methods are listed in the order of procedure necessary for carrying out the analysis. A comprehensive review of methods to be used with other types of apparatus is included in the appendix of the circular.

Copies of Circular No. 12 may be had without charge by addressing the Engineering Experiment Station, Urbana, Illinois.

The U. G. I. Contracting Company, Philadelphia, has received contract to furnish and install electric vibrating screens in connection with the new carbonizing plant of the Syracuse Lighting Company at Syracuse, New York. By means of these screens the coke will receive a screening treatment that could not be effected by the ordinary screen processes and it will enable the Syracuse Lighting Company to deliver to its customer a cleaner and more satisfactory domestic fuel than would otherwise be the case. The electric vibrating screen system is a new departure in connection with the handling of coke, and is meeting with considerable success.

The Jones & Laughlin Steel Corporation has placed a contract with the Koppers Company covering the design and erection of a complete by-product coke plant of Aliquippa, Pennsylvania. It consists of two batteries of 61 Koppers Company's Becker Type Coke and Gas Ovens with the necessary coal and coke handling, by-product and benzol recovery plants. The plant is designed to produce approximately 1900 tons of blast furnace coke per day.

The U. G. I. Contracting Company, of Philadelphia, has received contract from Harrisburg (Pa.) Gas Company to furnish and erect a 6,000,000 cu. ft. Waterless Storage Holder, including the necessary foundation and connections. The installation of this holder will, no doubt, excite considerable interest in the industry.

New Fuels May Mean the End of Waste

One of the most remarkable facts of the past few years, according to political economists, is the stability in the final cost of manufactured goods in spite of continually rising costs of labor, construction and raw materials. Some of this has been owing to quantity production, but a great deal is due to more efficient utilization of fuel. It has been found that this item affects practically every part of the manufacturing process.

The comparatively recent introduction of gas fuel into the industrial heating field has already done much, enabling manufacturers either to turn out the same product at lower cost, or a better product at substantially the same cost as before.

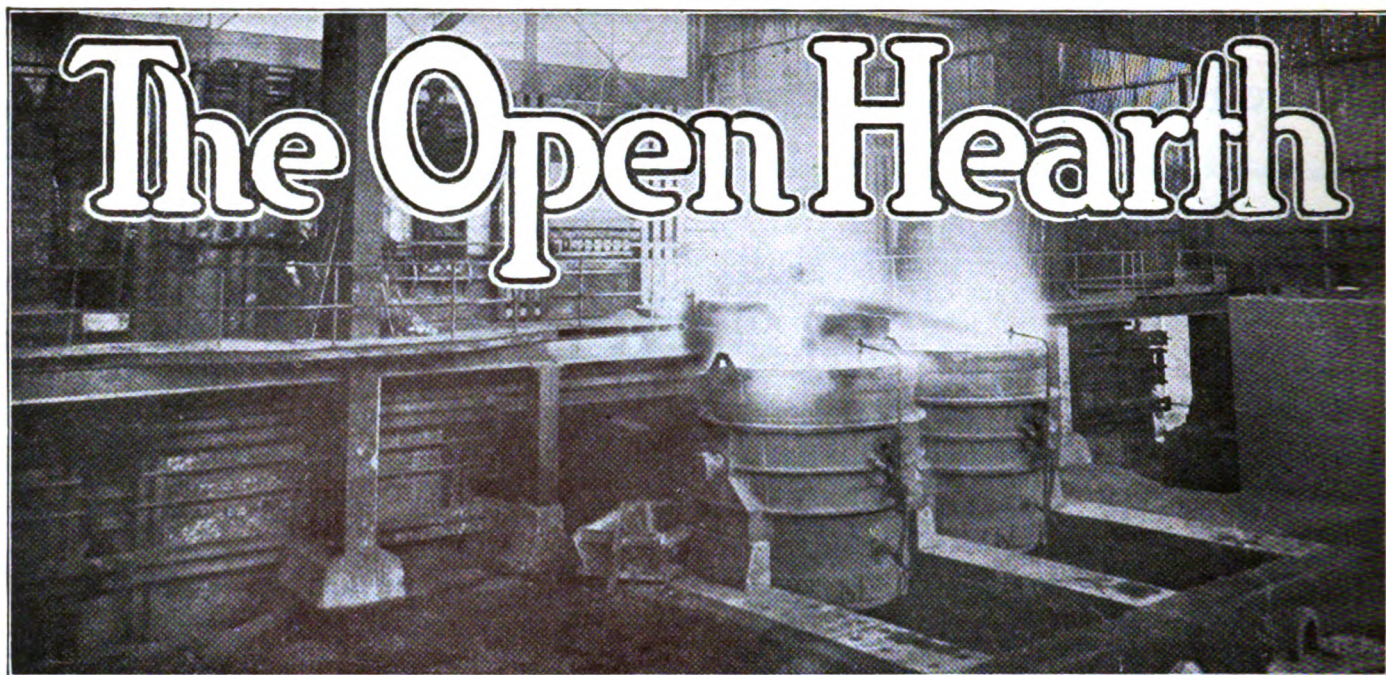
The example is given of a large tin decorating plant in New York which recently scrapped an antiquated combustion system, substituting modern gas-fired ovens. During the first year this resulted in a fuel saving of \$160 per month for four ovens. In addition, two men were shifted to other work, which meant a saving of \$55 per week. Production was increased 17 per cent.

In this way the new equipment actually paid for itself during the first 12 months of use.

With the present trend in conservation of essential fuels, economists as well as engineers have expressed the prediction that the practice of using wasteful and inefficient combustion methods in industry will be abandoned generally within the next few years.

The U. G. I. Contracting Company, of Philadelphia, has received contract from Allentown-Bethlehem Gas Company to furnish and erect at the coke oven plant of the Bethlehem Steel Company two 10 ft. 6 in. U. G. I. producers, together with the necessary blowing plant and appurtenances. There will also be installed two U. G. I. vertical waste heat boilers with connections to the producers. In addition, there will be installed an 8 ft. U. G. I. scrubber, 50 ft. high and a battery of gas exhausters with necessary connections. It is expected that the installation of this equipment will greatly increase the efficiency of the above plant.

In connection with the Parker-Russell Mining & Manufacturing Company, of St. Louis, the U. G. I. Contracting Company is furnishing and installing at the plant of the Consumers Power Company, in Kalamazoo, Mich., a 10 ft. 6 in. diameter U. G. I. producer plant complete with all accessories, also a 14 ft. U. G. I. dust arrester and flue connections, also a turbine blower plant in duplicate for blasting the producer, each blower having capacity of 3,000 cu. ft. of air per minute. This producer plant will furnish the gas for heating the carbonizing plant which Parker-Russell is installing.



The Tennessee Coal, Iron and Railroad Company during January broke four records, two at coal mines, one at an ore mine and one in the rail mill of the Ensley Steelworks. The rail mill produced 54,219 tons of rails, compared with 51,652 tons the best preceding record. The Edgewater coal mines produced 116,318 tons of coal, against 107,625 tons previously, and the Docena coal mines produced 72,815 tons compared with 71,879 tons previously. The No. 9 Wenonah ore mine produced 39,274 tons of ore against 37,151 tons previously.

The A. M. Byers Company has adopted a plan of group insurance for employees at the Girard, O., works. Workers who have been with the company 25 years or longer, will be protected without charge, the company paying the entire cost of premiums.

W. F. Scully, formerly president of the Advance Furnace & Engineering Company of Springfield, Mass., has rejoined the organization of the Gilbert & Barker Manufacturing Company as manager of Furnace and Factory sales. Mr. Scully was with the Gilbert & Barker Manufacturing Company from 1910 to 1920, leaving in the latter year to organize the Advance Furnace and Engineering Company. The patents, patterns, records, etc., of the Advance Company have been purchased by the Gilbert & Barker Manufacturing Company who will be in a position to supply repair parts for Advance Company equipment.

George W. Starr has resigned as purchasing agent of the United Alloy Steel Corporation, Canton, Ohio, and has been succeeded by C. A. Ilgenfritz, formerly purchasing agent of the Brier Hill Steel Company and recently assistant purchasing agent of the Youngstown Sheet & Tube Company.

Dr. Richard Moldenke, Watchung, N. J., has become associated actively with the Detroit Aero Metals Company, having complete charge of all technical operations.

Truman M. Dodson of Bethlehem, Pa., has been appointed vice president in charge of operations, and Arthur Neale has been made general manager of mines of the Pittsburgh Coal Company, succeeding J. A. Donaldson and J. M. Armstrong.

W. A. Shoudy has been appointed consulting engineer with special reference to combustion and furnace construction by the Bailey Meter Company, Cleveland. He will continue with his other consulting practice in steam power engineering from offices adjoining those of this company at 50 Church Street, New York, N. Y.

Howard Bateson, Jr., for the past five years identified with the Jones & Laughlin Steel Corporation at Milwaukee, has joined the sales force of Rogers, Brown & Company at Chicago.

British Institute Annual Meeting in May

The Annual Meeting of the British Iron and Steel Institute will take place on Thursday and Friday, May 7th and 8th, at the House of the Institution of Civil Engineers, Great George Street, London, S.W. 1, by kind permission of their Council.

The annual dinner will be held on the evening of Thursday, May 7th, at the Hotel Cecil, Strand, W.C. Particulars of the cost of the dinner, and details of the arrangements, will be circulated later.

Members are reminded that in March the Council is prepared to consider applications for grants from the Carnegie Fund, in aid of research work on some subject of practical importance relating to the metallurgy of iron and steel, or allied subjects. Special application forms can be obtained from the secretary of the institute. The results of research work must be communicated to the institute in the form of a report.

The Autumn Meeting will be held in Birmingham, on Wednesday, Thursday and Friday, September 9th, 10th and 11th. Further details of the arrangements will be announced later.

NEWS OF THE PLANTS

The American Steel & Wire Company, Chicago, Ill., is perfecting plans for expansion at its Cleveland, Ohio, blast furnaces. The program, as now arranged provides for the rebuilding of furnace D, with additional facilities to increase the capacity from 500 to 600 tons. The boiler plant will be enlarged and improved, and additional equipment installed, including similar expansion in the electric generating station and the installation of a 10,000 kw. turbo-generator. A new pumping plant will be constructed, replacing a portion of the present plant and providing for increased output. The project is reported to involve more than \$400,000. Other blast furnaces at the plant will remain substantially as at the present time, the unit A having been enlarged a number of months ago to develop an output of 600 tons per day, while two other furnaces at the plant have a rating of 550 tons daily.

The Elyria Iron & Steel Company, 232 East 131st Street, Cleveland, Ohio, has plans in progress for the construction of a new plant addition, consisting of a main structure, 160 x 160 feet, and a number of smaller buildings, estimated to cost close to \$200,000, with equipment. E. McGeorge, 303 Euclid Avenue, Cleveland, is architect. It is expected to proceed with the project at an early date.

The Youngstown Sheet & Tube Company, Youngstown, Ohio, is arranging details of its proposed expansion program, with a gross expenditure now estimated in excess of \$17,500,000, including current work and projected mills. It is planned to build a new seamless tube mill during the present year, on site either at Indiana Harbor, Ind., or East Youngstown, still to be decided. This unit will roll material from $4\frac{3}{4}$ to $8\frac{5}{8}$ in. in diameter, and will be fully equipped to develop an output of about 100,000 tons per annum. It will cost approximately \$2,000,000, complete. The company also has plans under way for about 10 to 12 new sheet mills at the Indiana Harbor works, and also purposes to construct 12 or more tin plate mills at points still to be determined, the work to go forward during the present year.

The McClintic-Marshall Company, Oliver Building, Pittsburgh, Pa., is completing the construction of a new steel fabricating plant on Central Avenue, near 110th Street, Los Angeles, Cal. It will consist of a main one-story building, 91 x 369 feet, with adjoining structure, 45 x 315 feet, and smaller structures, including a two-story office building. The plant is reported to cost in excess of \$175,000, including equipment. The company maintains offices at 424 South Spring Street, Los Angeles.

Following the discontinuance of production of bar iron some time ago, the Empire Rolling Mill Company, Cleveland, Ohio, has arranged for the dismantling of its puddling plant and muck bar mill, consisting of four single puddling furnaces, six single busheling furnaces, 10-in. and 16-in. bar mills, with accessory equipment. Operations will be maintained, as heretofore, in

the group of sheet mills, four cold rolling mills, and galvanizing plant, and it is expected to develop maximum capacity in these departments.

The Reeves Brothers Company, Alliance, Ohio, is pushing construction on its new steel fabricating plant at Bessemer, Ala., consisting of a series of five main buildings of different size, estimated to cost \$300,000, with machinery. The work will include the installation of complete equipment to develop a large capacity, and the plant will be placed in service at the earliest possible date. It will be operated as a branch of the main works at Alliance. A. G. Reeves is president.

The Carnegie Steel Company, Pittsburgh, Pa., is arranging for the rebuilding of the ore bins at its furnaces No. 1, 2, 5, 6 and 7, at the Homestead steel plant, in addition to other improvements to be made for greater efficiency in operation. New bottoms of Baker suspension type will be installed at the bins, while a transfer car of 40 tons capacity will be provided for conveying ore to the reconstructed bin units. It is expected to proceed with the work at an early date. A general contract has been awarded to Arthur G. McKee & Company, Cleveland, Ohio.

The American Tube & Stamping Company, Hancock Avenue, Bridgeport, Conn., has work under way on additions to its local plant, consisting of two main buildings, 62 x 450 feet, and 62 x 165 feet, to be equipped as rolling mills. The units are expected to provide employment for about 300 additional men and will be ready for service at an early date. The primary production will be devoted to small rolled steel specialties. The company will also make improvements and extensions in the electrical department at its plant, including the construction of substations and the installation of considerable electrical apparatus.

The Lukens Steel Company, Coatesville, Pa., has authorized the electrification of its 112-in. plate mill and will proceed with the improvement at an early date. The work will include the installation of a 3,000 hp. industrial motor for main service, and other electrical equipment for complete operation, replacing all present steam-operated equipment. The company is said to be planning for other improvements at the mill for greater efficiency in production.

The Central Steel Company, Massillon, Ohio, will proceed at once with the construction of the proposed new blast furnace at its plant, and has awarded a contract for excavating, grading and similar work to A. F. Wendling, Massillon. The new unit has been designed for a capacity of 600 tons, and will be fully equipped with most modern type apparatus, including ore-handling bridge, automatic buckets, etc. The project will include a new power plant for central station service at the mills, as well as other buildings and equipment for increased output in the different departments of the works.

The Blast Furnace *(and)* Steel Plant

Member of the Audit
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The ROLL Is The "HEART" Of The ROLLING MILL
The "HEART" MUST BE SOUND



WILL MAKE
IT SAFE
AND SOUND

ADAMITE IN THE HEART OF
YOUR MILLS HAS MADE
WORLDS RECORDS
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